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16. ABSTRACT

An advanced generalized urban air quality model (IBMAQ-2) is developed based on the theory utilized in an existing model (IBMAQ-1) as prescribed in Ref. 1. The model, based on numerical integration of the concentration equation, computes temporal and three-dimensional spatial concentration distributions resulting from specified urban point and area sources by using NEDS (National Emission Data System) and simulated RAMS (Regional Air Monitoring System) data. The UTM (Universal Transverse Metric) coordinates are used in all geographical, source emission, and monitoring data. A new menthod to incorporate point sources into the grid computation is developed by using a Lagrange trajectory method. Many model options are provided w which enable users to study conveniently the significant effects which these options have on the final concentration distribution

The program description is included to provided a guide for users. The program is constructed in a modular form which allows users to change or improve each componet conveniently. The input auxiliary model, which processes geographical, source emission, and monitoring data, is alos included.

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DEVELOPMENT OF AN URBAN AIR QUALITY SIMULATION MODEL WITH COMPATIBLE RAPS DATA

VOLUME II

by

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APPENDIX to

Final Report

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6. Finite Difference Scheme for the Horizontal Advection Terms of the Concentration Equation. 174-180

APPENDIX

1. Main Program Listing

1. IBMAQ-2 (MAIN)
2. AACOMP
3. AKZCAL
4. CADJUS
5. CHEMIC
6. CONSIN
7. DIMENS
8. DTTEST
9. GEOIN
10. OUTAPE
11. POSITV
12. PRINTS
13. SHIFTN
14. SOURCE
15. SOUSIN
16. STABIT
17. STNCON
18. TIMEX
19. UVFLUX
20. UVINTP
21. UVZF
22. WINDER
23. WINDGR
24. WINDIN
25. WRITES
26. WWFLUX
27. WWZF
28. XYDIFF
29. XYUTMS
30. ZZDIFF
31. ZZGRID

```
LEVEL 21.6 ( MAY 72 )                    OS/360  FORTRAN H                           DATE  75.120/09.05.
      COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                         SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
            C                                                                             00000010
            C           ************************                                          00000020
            C           ***  PROGRAM IBMAQ-2  ***                                         00000030
            C           ************************                                          00000040
            C                                                                             00000050
            C.... THIS PROGRAM COMPUTES 3-D CONCENTRATION DISTRIBUTION IN ST. LOUIS        00000060
            C....  AREA. REGION IS (40KM X 60KM X HH) IN (30,40,14) GRIDS.                00000070
            C.... THERE ARE 1200 AREA SOURCES AND 150 POINT SOURCES.                      00000080
            C.... GRADIENT TYPE CONCENTRATION EQUATION IS USED IN THIS MODEL.             00000090
            C     THE PROGRAM IS AN EXPERIMENTAL PROGRAM. IT IS FOR RESEARCH              00000100
            C     PURPOSE ONLY.                                                           00000110
            C     THE MODEL IS DISCUSSED IN IBM RESEARCH REPORT RJ1227,                   00000120
            C     'A GENERALIZED URBAN AIR POLLUTION MODEL AND ITS APPLICATION            00000130
            C     TO THE STUDY OF SO2 DISTRIBUTION IN ST. LOUIS METROPOLITAN AREA',       00000140
            C     BY SHIR AND SHIEH, 1973.                                                00000150
            C                                                                             00000160
            C *******************************************                                 00000170
            C *** SUBROUTINES INCLUDED IN THIS PROGRAM ***                                 00000180
            C *******************************************                                 00000190
            C                                                                             00000200
            C       NAME   CALLED FROM   FUNCTIONS                                        00000210
            C      ------  -----------   ---------------------------------------------   00000220
            C      AACOMP  MAIN          COMPUTE THE CONCENTRATION FIELDS                 00000230
            C      AKZCAL  MAIN          COMPUTE EDDY DIFFUSIVITY                         00000240
            C      CADJUS  MAIN          ADJUST C VALUES DUE TO CHANGE IN GRID DIMEN.     00000250
            C      CCHECK  AACOMP        CHECK FOR STEADY STATE CONDITION                 00000260
            C      CHEMIC  AACOMP        COMPUTE CHEMICAL DECAY                           00000270
            C      CONSIN  MAIN          SPECIFY MODEL PARAMETERS                         00000280
            C     *CDTOTP  MAIN          PRINT CARD IMAGE OF NAMELIST INPUT               00000290
            C      DIMENS  MAIN          INITIALIZE GRID SYSTEM                           00000300
            C     *DIMEN1  MAIN          SET VERTICAL GRID SYSTEM                         00000310
            C     *HHCALC  MAIN          COMPUTE TIME VARYING MIXING HEIGHT               00000320
            C      DTTEST  MAIN          TIME STEP FOR NUMERICAL METHOD                   00000330
            C      GEOIN   MAIN          INPUT GEOGRAPH. AND ANNUAL EMISSION DATA         00000340
            C      OUTAPE  MAIN          OUTPUT RESULTS TO TAPE OR DISK                   00000350
            C      POSITV  (NOT USED)    SET C=0 IF IT IS LESS THAN ZERO                  00000360
            C      PRINTS  MAIN          PRINT GEOGRAPH. AND ANNUAL EMISSION DATA         00000370
            C     *PRINTA  MAIN          PRINT TIME VARYING EMISSION RATES                00000380
            C     *PRINTB  MAIN          PRINT TIME VARYING METEOROLOGICAL DATA           00000390
            C     *PRINTC  MAIN          PRINT CONCENTRATION FIELDS                       00000400
            C      SHIFTN  MAIN,AACOMP   SHIFT ARRAY A TO ARRAY B                         00000410
            C      SOURCE  AACOMP        ADD NEW SOURCE EMISSION INTO THE SYSTEM          00000420
            C      SOUSIN  MAIN          INPUT TIME VARYING SOURCE EMISSION RATE          00000430
            C      STABIT  WINDIN        ESTIMATE CONTINUOUS STABILITY CLASSES            00000440
            C      STNCON  PRINTC        COMPUTE CONC. VALUES AT RAMS STATIONS            00000450
            C      TIMEX   MAIN          FIX TIME INDICES                                 00000460
            C      UVZF    WINDIN        COMPUTE VERTICAL WIND PROFILE OF (U,V)           00000470
            C      UVFLUX  AACOMP        COMPUTE HORIZONTAL ADVECTION                     00000480
            C      UVINTP  WINDIN,WINDGR INTERPOLATE ANALYZED U,V TO NUMERICAL GRID       00000490
            C      WWZF    WINDIN        COMPUTE W COMONENT OF WIND                       00000500
            C      WINDER  WINDGR,UVZF   CONVERT WIND VECTOR TO COMP. OR VICE VERSA       00000510
            C      WINDGR  WINDIN        GENERATE SFC. WIND FIELD FROM RAMS DATA          00000520
            C      WINDIN  MAIN          READ IN SURFACE WIND FIELD AND RAMS DATA         00000530
            C      WRITES  PRINTS        PRINT DATA ARRAY                                 00000540
            C     *WRITEX  PRINTS        PRINT HORIZONTAL FIELD OF ARRAY                  00000550
            C     *WRITEZ  PRINTC        PRINT VERTICAL CROSS-SECTION OF ARRAY            00000560
```

```
C       WWFLUX  AACOMP         COMPUTE VERTICAL ADVECTION                     00000570
C       XYDIFF  MAIN           COMPUTE HORIZONTAL DIFFUSION                   00000580
C       XYUTMS  GEOIN          COMPUTE UTM COORDINATE OF NEMERICAL GRID       00000590
C      *XYUTM1  GEOIN,SOURCE   CONVERT (X,Y) FROM UTM TO NUMERICAL GRID       00000600
C       ZZDIFF  AACOMP         COMPUTE VERTICAL DIFFUSION                     00000610
C       ZZGRID  SOURCE         CONVERT Z FROM METER TO NUMERICAL GRID UNIT    00000620
C       ------  ------------   ---------------------------------------------- 00000630
C       (NOTE: * DENOTE ENTRY POINT TO LAST STATED SUBROUTINE)                00000640
C                                                                             00000650
C ***************************                                                 00000660
C *** TABLE FOR I/O UNITS ***                                                 00000670
C ***************************                                                 00000680
C                                                                             00000690
C       UNIT  *   DSNAME   *I/O* ROUTINE *   VARIABLES                        00000700
C       ------*------------*---*---------*------------------------------------00000710
C       IUNIT                I   MAIN     'NAMELIST'  (IUNIT=IUNIT2)          00000720
C       IUNIT1               I   CDTOTP    (UNIT FOR CARD READER)             00000730
C       IUNIT2              I/O  CDTOTP    (SCRATCH STORAGE UNIT)             00000740
C       JUNIT                O   (ALL)     (UNIT FOR LINE PRINTER)            00000750
C       JUNIT1               O   CDTOTP    (UNIT FOR LINE PRINTER)            00000760
C       KUNITG   EPAGEO2     I   GEOIN    XRAMS,ZS,ZO,QB,PQB,.....            00000770
C       KUNITS   SO2SOUS1    I   SOUSIN   KHR,KMO,KDAY,KYR,QB,PQB,            00000780
C       KUNITW   WINDDATA    I   WINDIN   KYR,KMO,KDAY,KHR,U1,V1,RAMS         00000790
C       KUNITW   WINDDATE    I   WINDIN   KYR,KMO,KDAY,KHR,UU,VV,RAMS         00000800
C       KUNITW   EPARAMS     I   WINDIN   KYR,KMO,KDAY,KHR,RAMS               00000810
C       KUNITC   EPASTNC1    O   OUTAPE   IYR,IMO,IDAY,IHR,PARM,ICAL,IOBS     00000820
C       KUNITP   EPACONC1    O   OUTAPE   IYR,IMO,IDAY,IHR,PARM,CC,           00000830
C                                         ICAL,IOBS                           00000840
C       ----------------------------------------------------------------------00000850
C                                                                             00000860
C ************************************************                            00000870
C *** COMMENTS ON VARIABLES USE IN THIS PROGRAM ***                           00000880
C ************************************************                            00000890
C                                                                             00000900
C .... C .... C .... C .... C                                                 00000910
C .. APPEAR IN DIMENSION .. C                                                 00000920
C .... C .... C .... C .... C                                                 00000930
C                                                                             00000940
C      CP1,C           = NEW AND OLD CONCENTRATION FIELD (UG/M3)              00000950
C      U,V,W           = WIND COMPONENT IN X,Y,Z DIRECTIONS (M/SEC)           00000960
C      COLD            = OLD SURFACE C FOR CHECKING CONVERGENCE               00000970
C      CC              = (HOURLY) AVERAGE SURFACE CONCENTRATION               00000980
C      C1              = NEW SURFACE CONCENTRATION                            00000990
C      U1,V1           = SURFACE WIND COMPONENTS IN X,Y DIRECTIONS            00001000
C      QA,QB           = NEW,OLD AREA SOURCE EMISSION RATE (G/SEC/KM2)        00001010
C                              (CURRENT--ONLY QB IS USED)                     00001020
C      ZS              = AREA SOURCE HEIGHT (M)                               00001030
C      ZO              = SURFACE ROUGHNESS (M)                                00001040
C      AKZ             = VERTICAL EDDY DIFFUSIVITY (M2/SEC)                   00001050
C      UU,VV           = SURFACE WIND FIELD ON WIND GRID POINTS               00001060
C      NEAR            = NEAREST RAMS STATION TO WIND GRID (IN,JN)            00001070
C      DX,DY,DZ        = NON-UNIFORM GRID SIZE IN X,Y,Z DIRECTION (M)         00001080
C      (DXS,DYS,DZS)   = SQUARE OF (DX,DY,DZ)                                 00001090
C      (RDX,RDY,RDZ)   = (DX(I)/DX(I-1),DY(J)/DY(J-1),DZ(K)/DZ(K-1))          00001100
C      Z               = HEIGHT OF GRID POINT FROM SURFACE (M)                00001110
C      ZM              = HEIGHT OF POINT IN THE MIDDLE OF GRID (M)            00001120
C      AKH             = HORIZONTAL EDDY DIFFUSIVITY (M2/SEC)                 00001130
C      AKF             = FUNCTION DETERMINES VERTICAL VARIATION OF AKZ        00001140
```

```
C     UZF,VZF,WZF   = FUNCTION DETERMINES VERTICAL VARIATION OF U,V,W    00001150
C     NP            = POINT SOURCE IDENTIFICATION NUMBER                00001160
C     XP,YP,ZP      = X,Y,Z COORDINATE OF POINT SOURCE                  00001170
C     ZR            = NORMALIZED PLUME RISE (M*(M/SEC)**.75)            00001180
C     ZPR           = EFFECTIVE STACK HEIGHT OF POINT SOURCES (M)       00001190
C     PQA,PQB       = NEW, OLD POINT SOURCE EMISSION RATE (G/SEC)       00001200
C                         (CURRENT--ONLY PQB IS USED)                   00001210
C     EK,FK         = TEMPORARY STORAGE ARRAY                           00001220
C     USTN,VSTN     = U,V COMPONENTS AT RAMS STATION                    00001230
C     IS,XS,YS      = NUMBER AND X,Y LOCATION OF RAMS STATIONS          00001240
C     (JXS,JYS)     = (XS,YS) ON GRID UNIT                              00001250
C     ICAL,IOBS     = (HOURLY) CAL. AND OBS. C AT RAMS STATION (UG/M3)  00001260
C                          (ICAL(NSX),IOBS(NSX) = SPATIAL AVERAGE)      00001270
C     KCAL,KOBS     = 24 HOURS AVERAGE OF ICAL, IOBS                    00001280
C     ITOBS         = NUMBER OF OBS. DATA AT STATION FOR 24 HR. PERIOD  00001290
C     IUTM,JUTM     = UTM COORDINATE OF NUMERICAL GRID POINTS           00001300
C     XPUTM,YPUTM   = UTM COORDINATES OF POINT SOURCE                   00001310
C     XSUTM,YSUTM   = UTM COORDINATES OF RAMS STATION                   00001320
C     AKA           = CHEMICAL REACTION RATE CONSTANT (/SEC)            00001330
C     NMONDY        = NUMBER OF DAYS IN A MONTH                         00001340
C                                                                       00001350
C .... C .... C .... C ... C                                            00001360
C .. APPEAR IN NAMELIST .. C                                            00001370
C .... C .... C .... C ... C                                            00001380
C                                                                       00001390
C     IM,JM,KM  = 3-D DIMENSION IN X,Y,Z DIRECTION                      00001400
C     TM,ITM    = SIMULATED TIME IN SECOND                              00001410
C     DT        = TIME STEP (SEC)                                       00001420
C     IN,JN     = DIMENSION IN X,Y DIRECTION OF WIND GRID               00001430
C     KN        = NUMBER OF LEVELS THAT WIND FIELD  WILL BE COMPUTED    00001440
C     KNN       = NUMBER OF FIXED GRID INTERVAL IN VERTICAL DIRECTION   00001450
C     LM        = TOTAL NUMBER OF POINT SOURCES                         00001460
C     NS        = TOTAL NUMBER OF RAMS STATIONS                         00001470
C     IMC,JMC   = THE CROSS SECTION TO PRINT VERTICAL C DISTRIBUTION    00001480
C     HS        = AVERAGED EFFECTIVE HEIGHT OF SURFACE WIND             00001490
C     HP        = HEIGHT OF UPPER WIND MEASUREMENT                      00001500
C     HG        = THICKNESS OF PLANETARY BOUNDARY LAYER                 00001510
C     HMIN,HMAX = MIN. AND MAX. MIXING HEIGHT OF A DAY                  00001520
C     ZRPQ      = RATIO OF PLUME RISE TO SOURCE EMISSION RATE           00001530
C     ZRISE     = PARAMETER FOR ADJUSTING PLUME RISE                    00001540
C     PMAX,PMIN = MAX. AND MIN. FOR POWER LAW CONSTANT OF WIND PROFILE  00001550
C     DCMIN     = CRITERIA FOR CONVERGENCE OF STEADY STATE              00001560
C     OLMIN     = MIN. LIMIT OF OBUKHOV-MONIN LENGTH                    00001570
C     IHR,IDAY,IMO,IYR = REAL TIME OF HOUR, DAY, MONTH & YEAR           00001580
C     LTSTOP    = MAX. NUMBER OF HOURS TO BE SIMULATED IN A RUN         00001590
C     LTSOUS    = TIME INTERVAL FOR INPUT SOURCE DATA (SECONDS)         00001600
C     LTWIND    = TIME INTERVAL FOR INPUT WIND & METEOR DATA (SECONDS)  00001610
C     IDAYTP,IHRTP = STARTING DAY AND HOUR THAT DATA STORED ON          00001620
C                         I/O UNIT = KUNITP & KUNITC                    00001630
C     JUNIT     = OUTPUT UNIT FOR LINE PRINTER                          00001640
C     KUNITG    = INPUT UNIT FOR GEOGRAPHICAL & NEDS DATA               00001650
C     KUNITS    = INPUT UNIT FOR HOURLY SOURCES EMISSION RATE           00001660
C     KUNITW    = INPUT UNIT FOR OBJ. WIND & RAMS DATA                  00001670
C     KUNITW    = INPUT UNIT FOR SUBJ. WIND (UU,VV) & RAMS DATA         00001680
C     KUNITW    = INPUT UNIT FOR RAMS DATA                              00001690
C     KUNITC    = I/O UNIT FOR COMP. SO2 CONC AT STATION                00001700
C     KUNITP    = I/O UNIT FOR COMPUTED SURFACE CONC. FOR A TAPE        00001710
C     LCRUN     = FLAG TO DECIDE DEBUG RUN OR ACTUAL RUN                00001720
```

```
C       LHJUS      = FLAG FOR ADJUSTING  C VALUE DUE TO GRID CHANGED
C       LCHEM      = FLAG TO DECIDE THE CHEMICAL REACTION COMPUTATION
C       LWW        = FLAG FOR COMPUTING VERTICAL WIND ADVECTION
C       LTOP       = FLAG FOR CHOICE OF UPPER BOUNDARY CONDITION-DIFFUSION
C       LWTOP      = FLAG FOR CHOICE OF UPPER BOUNDARY CONDITION-ADVECTION
C       LSOUS      = FLAG USED IN ADDING NEW SOURCE INTO SYSTEM
C       LPQ        = FLAG FOR CHOICE OF MODELING POINT SOURCE
C       LWIND      = FLAG FOR COMPUTING UPPER LAYER WIND FIELD
C       KWIND      = FLAG FOR CHOICE OF OBJECTIVE OR SUBJECTIVE
C                       ANALYZED WIND FIELD
C       Z0MEAN     = VALUE THAT UNIFORM SFC ROUGHNESS TO BE USED
C       LWRITE(N) = CONTROL FLAG FOR OUTPUT.
C         ROUTINE    N   COND.     VARIABLES TO BE OUTPUT
C         -------   ---  ------    --------------------------------------
C         PRINTS     1   .GE. 1    IS,XSUTM,YSUTM,XS,YS,JXS,JYS(L),L=1,NS
C                                  ZO(I,J),ZS(I,J),QB(I,J),QBTOT,QBSUM
C                                  NP,XPUTM,YPUTM,PQB,XP,YP,ZP,ZF(L),L=1,LM
C                                  PQBTOT,PQBSUM
C         PRINTA     2   .GE. 1    QBTOT,PQBTOT,QBSUM,PQBSUM
C                         = 2,4    QB(I,J)
C                         = 3,4    PQB(L)
C         PRINTB     3   .GE. 1    RAMS(M,L)
C                         =   2    UU(I,J),VV(I,J)
C                    4   .GE. 2    U1(I,J),V1(I,J)
C                                  + W(I,J,1), (IF LWW=1)
C                         =   3    U(I,J,K),V(I,J,K)
C                                  + W(I,J,K), (IF LWW=1)
C                        .NE. 0    Z(K),RH
C                        .GE. 1    UZF(K),VZF(K)
C                                  + WZF(K), (IF LWW=1)
C                    5   .GE. 1    AKF(K)
C                         =   2    AKZ(I,J), FOR J=JM/2
C                         =   3    AKZ(I,J)
C                    6   .GE. 1    PARM(L),DT
C                         =   2    UD,PHIFHZ,HFZ,RIB
C         PRINTC     7    = 2,4    CP1(JXS,JYS)
C                        .GE. 1    CP1(IMC,J,K),CP1(I,JMC,K)
C                        .GE. 3    CP1(I,J,1)
C                                  CP1(I,J,K), (IF IHR=0)
C                    8   .GE. 1    ICAL(L),IOBS(L)
C                                  + KCAL(L),KOBS(L), (IF IHR=0)
C                         =   2    CC(I,J)
C         OUTAPE     9   .GE. 1    IYR,IMO,IDAY,IHR,PARM(M),ICAL(L),IOBS(L)
C                                          -- ON I/O UNIT=KUNITC
C                   10   .GE. 1    IYR,IMO,IDAY,IHR,PARM(M),CC(I,J),ICAL(L),
C                                  & IOBS(L) -- ON I/O UNIT=KUNITP
C         ----------------------------------------------------------------
C
C ... C .... C .... C ... C
C ... APPEAR IN COMMON .. C
C ... C .... C .... C ... C
C
C       IM1,JM1,KM1   = IM,JM,KM MINUS ONE
C       ITM,TM        = SIMULATED TIME IN SECONDS
C       ITSEC,TSEC    = TIME IN SECONDS STARTING FROM EACH 1 HR INTERVAL
C       ITOTHR        = TOTAL REAL TIME BEING SIMULATED IN HOURS
C       ITMHR         = SIMULATED TIME IN HOUR ( - ITM/3600*3600)
C       ITSTEP        = NUMBER OF TIME STEPS
```

```
             C      LPRINT        = MIN. OF (LTWIND,LTSOUS), TIME INTERVAL FOR        00002310
             C                      TAKING AVERAGE OF CONCENTRATION                   00002320
             C      RAMS(M,N)     = RAMS STATION DATA, N -- STATION INDEX             00002330
             C                     M=1 WIND SPEED;          =2 WIND DIRECTION;        00002340
             C                      =3 1ST LEVEL TEMP.;     =4 2ND LEVEL TEMP.;       00002350
             C                      =5 SO2 CONCENTRATION;  =6 RADIATION              00002360
             C      PARM(M)       = METEOROLOGICAL PARAMETERS                         00002370
             C                     M=1 MEAN WIND SPEED;      =2 WIND DIRECTION;       00002380
             C                      =3 SURFACE TEMP.;        =4 STABILITY CLASS;      00002390
             C                      =5 MIXING HEIGHT;        =6 AREA SOURCE Q;        00002400
             C                      =7 POINT SOURCE Q;       =8 UPPER TEMP.;          00002410
             C                      =9 RADIATION;            =10 OBUKHOV LENGTH       00002420
             C      A1            = CONSTANTS IN BUSINGER'S FORMULA                   00002430
             C      AK            = VON KARMEN CONSTANT                               00002440
             C      RIB           = BULK RICHARDSON NUMBER                            00002450
             C      ZMAX          = MAXIMUN  MIXING HEIGHT USED IN THE MODEL          00002460
             C      QRTOT,PQBTOT  = TOTAL AREA AND POINT SOURCES Q OF INPUT DATA      00002470
             C      UO            = FRICTION VELOCITY                                 00002480
             C      PHIFHZ        = NON-DIMENSIONAL TEMP. GRADIENT                    00002490
             C      HFZ           = INTEGRAL OF NON-DIMENSIONAL WIND SHEAR            00002500
             C                                                                        00002510
             C                                                                        00002520
             C *********************                                                  00002530
             C ***  MAIN PROGRAM ***                                                  00002540
             C *********************                                                  00002550
             C                                                                        00002560
ISN 0002           DIMENSION                                                          00002570
             C    *     CP1(30,40,14),C(30,40,14),U(30,40,7),V(30,40,7),W(30,40,7)    00002580
             C    *     CP1(30,40,14),C(30,40,14),U(30,40,1),V(30,40,1),W(30,40,1)    00002590
             C    *     CP1(30,40,5),C(30,40,5),U(30,40,1),V(30,40,1),W(30,40,1)      00002600
             C    *     U(30,40,7),V(30,40,7),W(30,40,7)                              00002610
                  *     U(30,40,1),V(30,40,1),W(30,40,1)                              00002620
                  *     ,COLD(30,40),  CC(30,40),  C1(30,40),  U1(30,40),  V1(30,40)  00002630
                  *     ,  QA(30,40),  QB(30,40),  ZS(30,40),  Z0(30,40), AKZ(30,40)  00002640
                  *     ,  UU( 9,13),  VV( 9,13),NEAR( 9,13)                          00002650
                  *     ,   DX(30),  RDX(30),  DXS(30),   DY(40),  RDY(40),  DYS(40)  00002660
                  *     ,   DZ(14),  RDZ(14),  DZS(14),    Z(14),   ZM(14),  AKH(14)  00002670
                  *     ,  AKF(14),  UZF(14),  VZF(14),  WZF(14)                      00002680
                  *     ,  NP(150),  XP(150),  YP(150),  ZP(150),  ZR(150), ZPR(150)  00002690
                  *     , PQA(150), PQB(150),  EK(150),  FK(150), USTN(25)  VSTN(25)  00002700
                  *     ,   IS(25),   XS(25),   YS(25),  JXS(25),  JYS(25)            00002710
                  *     , IOBS(26), ICAL(26), KOBS(26), KCAL(26),ITOBS(26)            00002720
                  *     ,IUTM(30),JUTM(40),XPUTM(150),YPUTM(150),XSUTM(25),YSUTM(25)  00002730
                  *     , AKA(24), NMONDY(12)                                         00002740
             C                                                                        00002750
ISN 0003           COMMON    /AADATA/                                                 00002760
                  *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW            00002770
                  *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC       00002780
                  *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                     00002790
                  *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM  00002800
                  *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,OCMIN               00002810
                  *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ        00002820
ISN 0004           COMMON /CBLOCK/ CP1(30,40,14),C(30,40,14)                          00002830
             C     COMMON /CBLOCK/ CP1(30,40,5),C(30,40,5)                            00002840
             C                                                                        00002850
ISN 0005           EQUIVALENCE                                                        00002860
                  *        (CP1(1,1,1), C1(1,1))                                      00002870
                  *       ,(  U(1,1,1),  W(1,1,1))                                    00002880
```

```
                    *       ,(U(1,1,1),U1(1,1)), (V(1,1,1),V1(1,1))
                    *       , (QA(1,1),QB(1,1)),    (PQA(1), PQB(1))
                    *       ,   (UZF(1),VZF(1)),      (UZF(1),WZF(1))
                C   *       ,   (UU(1,1),EK(1)),      (VV(1,1),FK(1)), (NEAR(1,1),NP(1))
                C   *       , (USTN(1),EK(120)),  (VSTN(1),FK(120))
                C
ISN 0006             NAMELIST   /INLIST/
                    *   IM,JM,KM,DX,DY,DZ,TM,DT,IN,JN,KN,KNN,LM,NS,IMC,JMC, AKH
                    *  ,AKA,HS,HP,HG,ZMAX,HMIN,HMAX,ZRPQ,ZRISE,PMAX,PMIN,DCMIN,OLMIN
                    *  ,IHR,IDAY,IMO,IYR,LTSTOP,LTSOUS,LTWIND,IDAYTP,IHRTP
                    *  ,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW
                    *  ,LCRUN,LHJUS,LCHEM,LWW,LTOP,LWTOP,LSOUS,LPQ,KWIND,LWIND,LWRITE
                    *  ,ZOMEAN
                C
ISN 0007             DATA
                    *   ZS/1200*10./,Z0/1200*1./,QA/1200*0./,CC/1200*0./,COLD/1200*0./
                    *   ,RH/1.0/,ZPR/150*20.0/
                    *   ,UZF/14*1./,VZF/14*1./,WZF/14*1./,AKF/14*1./
                    *   ,IOBS/26*0/,ICAL/26*0/,KOBS/26*0/,KCAL/26*0/,ITOBS/26*0/
                    *   ,NMONDY/31,28,31,30,31,30,31,31,30,31,30,31/
ISN 0008             DATA IUNIT1/5/,IUNIT2/12/,JUNIT1/6/
                C
                C **************
                C ***  INPUT ***
                C **************
                C
                C *** COPY INPUT CARDS TO DISK TO BE LISTED ***
                C
ISN 0009            CALL     CDTOTP     (JUNIT1,IUNIT1,IUNIT2)
ISN 0010            IUNIT=IUNIT2
ISN 0011            READ  (IUNIT,INLIST)
                C     WRITE (JUNIT,INLIST)
                C
                C *** INPUT CONSTANTS ***
                C
ISN 0012            CALL     CONSIN     (IM,JM,KM.KN,IMJM,IJKM,IJKN)
                C
                C *** INITIALIZE ARRAY ***
                C
ISN 0013            DO 50 J=1,JM
ISN 0014            DO 50 I=1,IM
ISN 0015            DO 20 K=1,KN
ISN 0016            U(I,J,K)=0.0
ISN 0017            V(I,J,K)=0.0
ISN 0018            W(I,J,K)=0.0
ISN 0019         20 CONTINUE
ISN 0020            DO 30 K=1,KM
ISN 0021            CP1(I,J,K)=0.0
ISN 0022            C  (I,J,K)=0.0
ISN 0023         30 CONTINUE
ISN 0024         50 CONTINUE
                C
                C *** INPUT GEOGRAPHIC AND NEDS DATA ***
                C
ISN 0025            LMAX=LM
ISN 0026            CALL     GEOIN
                  & (QA,ZS,Z0,PQA,XPUTM,YPUTM,XP,YP,ZP,ZR,NP,IUTM,JUTM,DX,DY,IM,JM
                  &   ,LMAX,LM,XSUTM,YSUTM,XS,YS,IS,JXS,JYS,ZS,NS,KUNITG,JUNIT,QBSUM
```

```
                   &    ,PQBSUM,QBTOT,PQBTOT,ZOMEAN)
                C
                C.... QBSUM  = TOTAL AREA SOURCE EMISSION WITHIN THE COMPUTING REGION
                C              OR TOTAL EMISSION USED IN THE MODEL.
                C     PQBSUM = SAME DEF. AS QBSUM FOR POINT SOURCE
                C     QBTOT  = TOTAL AREA SOURCE EMISSION FROM INPUT DATA
                C     PQBTOT = TOTAL POINT SOURCE EMISSION FROM INPUT DATA
ISN 0027              NSX=NS+1
ISN 0028              PARM(6)=QBSUM
ISN 0029              PARM(7)=PQBSUM
                C
                C *** INITIALIZE NUMERICAL GRID SYSTEM ***
                C
ISN 0030              CALL      DIMENS  (DX,DY,DZ,RDX,RDY,RDZ,DXS,DYS,DZS,Z,ZM,IM,JM,KM)
                C
                C *** PRINT GEOGRAPHIC AND NEDS DATA ***
                C
ISN 0031              CALL      PRINTS
                    & (CP1,CC,C1,COLD,IOBS,ICAL,KOBS,KCAL,ITOBS,U,V,W,U1,V1,UU,VV
                    & ,AKZ,UZF,VZF,WZF,AKF,DX,DY,IUTM,JUTM,XSUTM,YSUTM,XPUTM,YPUTM
                    & ,ZO,ZS,QB,PQB,XP,YP,ZP,ZR,NP,IN,JN,KN,LM,IS,XS,YS,JXS,JYS,Z
                    & ,IM,JM,KM,NS,NSX)
                C
                C ***************************
                C *** ENTERING MAIN LOOP ***
                C ***************************
                C
                C     IF (ICASE .EQ. 2) GO TO 2000
                C
ISN 0032         1000 CONTINUE
                C
                C *** SEARCH AND STORED DATA OF CC,ICAL,IOBS ***
                C.... SUBROUTINE OUTAPE PERFORM I/O ON UNIT=KUNITP & KUNITC.
                C
ISN 0033              CALL      OUTAPE      (CC,ICAL,IOBS,NSX,IM,JM,IDAYTP,IHRTP,LWARM)
                C
                C *** TERMINATE THE COMPUTATION IF SPECIFIED TIME BEING REACHED ***
                C
ISN 0034              IF (ITOTHR .GE. LTSTOP) GO TO 9000
                C
                C.... PRINT REAL TIME FOR LINE PRINTER OUTPUT.
ISN 0036              IF (ITM.EQ.ITMHR) WRITE (JUNIT,8000) IYR,IMO,IDAY,IHR
ISN 0038         8000 FORMAT (1H1,' ... IYR,IMO,IDAY,IHR = ',4(I2,'/'),' ......')
                C
                C *** INPUT TIME VARYING SOURCE EMISSION RATE ***
                C
                C     IF (ITM .NE.(ITM/LTSOUS*LTSOUS)) GO TO 100
                C
                C     CALL      SOUSIN
                C    & (QB,ZS,ZO,PQB,XP,YP,ZP,ZR,IM,JM,LM)
                C
                C *** PRINT TIME VARYING SOURCE EMISSION DATA ***
                C
                C     CALL      PRINTA
                C
                C 100 CONTINUE
                C
ISN 0039              IF (ITM.NE.ITMHR) GO TO 200
```

```
                  C
                  C *** OBTAIN MIXING HEIGHT ***
                  C
ISN 0041                CALL     HHCALC       (HH,HMIN,HMAX)
                  C.... HH = HOURLY AVERAGE MIXING HEIGHT.
ISN 0042                PARM(5)=HH
                  C
                  C *** ADJUST VERTICAL GRID DUE TO CHANGE IN MIXING HEIGHT ***
ISN 0043                IF (KNN .GT. KM) KNN=KM
                  C
ISN 0045                CALL     DIMEN1       (DZ,RDZ,DZS,Z,ZM,KM,KNN,RH)
                  C
ISN 0046                IF((ABS(RH-1.0)) .LE. 0.01) GO TO 200
                  C *** ADJUST C DUE TO CHANGE IN VERTICAL GRID ***
                  C
ISN 0048                CALL     SHIFTN      (CP1,  C,IM,JM,KM,IM,JM,KM)
                  C
ISN 0049                CALL     CADJUS
                       & (CP1,C,RDZ,IM,JM,KM,IMJM,IJKM,KNN,RH,LHJUS)
                  C
ISN 0050            200 CONTINUE
                  C
                  C *** READ IN WIND DATA AND CALCULATE HORI & VERT WIND PROFILES ***
ISN 0051                IF (ITM .NE.(ITM/LTWIND*LTWIND)) GO TO 250
                  C
ISN 0053                CALL     WINDIN
                       & (U,V,W,U1,V1,UU,VV,NEAR,USTN,VSTN,UZF,VZF,WZF,XSUTM,YSUTM
                       & ,IUTM,JUTM,Z,DX,DY,DZ,IM,JM,KM,IMJM,IJKN,IN,JN,KN,IS,NS)
                  C
                  C *** COMPUTE VERTICAL EDDY DIFFUSIVITY ***
                  C
ISN 0054                CALL     AKZCAL       (AKZ,U,V,Z0,AKF,AKH,ZM,IMJM,IJKN,KM)
ISN 0055            250 CONTINUE
                  C
                  C *** CHECK TIME STEP ***
ISN 0056                IF(ITM .NE.(ITM/LTWIND*LTWIND)) GO TO 300
ISN 0058                AKAHR=AKA(IHR+1)
                  C
ISN 0059                CALL     DTTEST
                       & (U,V,AKH,AKZ,AKF,AKAHR,UZF,VZF,DX,DY,Z,IM,JM,KM,IMJM,IJKN,KN)
                  C
                  C *** PRINT METEOROLOGICAL DATA AND PARAMETERS OF NUMERICAL GRID ***
                  C
ISN 0060                CALL     PRINTB      (RH)
                  C
                  C ******************************
                  C *** ENTERING TIME STEP LOOP ***
                  C ******************************
                  C
ISN 0061            300 CONTINUE
                  C
                  C *** COMPUTE CONCENTRATION FIELD ***
                  C
ISN 0062                IF (LCRUN.EQ.1)      CALL      AACOMP
                       & (CP1,C,CC,COLD,U,V,W,ZS,QA,PQA,AKZ,AKH,AKA,AKF,UZF,VZF,WZF
                       & ,DX,RDX,DXS,DY,RDY,DYS,EK,FK,DZ,RDZ,DZS,Z,ZM,XPUTM,YPUTM,XP,YP
                       & ,ZP,ZP,ZPR,IM,JM,KM,KN,LM,IMJM,IJKM,IJKN)
                  C
```

```
               C *** FIX TIME INDICIES ***                                          00004630
               C                                                                    00004640
  ISN 0064           CALL     TIMEX     (NMONDY)                                    00004650
               C                                                                    00004660
               C *** PRINT COMPUTED CONCENTRATION FIELD ***                         00004670
               C                                                                    00004680
  ISN 0065           CALL     PRINTC     (IMC,JMC)                                  00004690
  ISN 0066           IF (ITM.NE.(ITM/LPRINT*LPRINT)) GO TO 300                      00004700
               C                                                                    00004710
  ISN 0068           GO TO 1000                                                     00004720
               C                                                                    00004730
               C ***************************************************               00004740
               C *** PROGRAM FOR CASE STUDY AND CLIMATICAL STUDY ***                00004750
               C ***************************************************               00004760
               C.... THIS PORTION OF THE PROGRAM YET TO BE DEVELOPED                00004770
               C                                                                    00004780
               C2000 CONTINUE                                                       00004790
               C                                                                    00004800
               C     CALL     CASE2                                                 00004810
               C    & (CP1,C,CC,COLD,U,V,W,ZS,QA,PQA,AKZ,AKH,AKA,AKF,UZF,VZF,WZF    00004820
               C    & ,DX,RDX,DXS,DY,RDY,DYS,EK,FK,DZ,RDZ,DZS,Z,ZM,XPUTM,YPUTM,XP,YP 00004830
               C    & ,ZP,ZR,ZPR,IM,JM,KM,KN,LN,IMJM,IJKM,IJKN)                     00004840
               C                                                                    00004850
  ISN 0069      9000 CONTINUE                                                       00004860
  ISN 0070           STOP                                                           00004870
               C     DEBUG SUBCHK                                                   00004880
  ISN 0071           END                                                            00004890
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      70 ,PROGRAM SIZE =    52948

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                101K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                 C                                                                      00004900
  ISN 0002             SUBROUTINE AACOMP                                                00004910
                     & (CP1,C,CC,COLD,U,V,W,ZS,QA,PQA,AKZ,AKH,AKA,AKF,UZF,VZF,WZF       00004920
                     & ,DX,RDX,DXS,DY,RDY,DYS,EK,FK,DZ,RDZ,DZS,Z,ZM,XPUTM,YPUTM,XP,YP,ZP00004930
                     &     ,ZR,ZPR,IM,JM,KM,KN,LM,IMJM,IJKM,IJKN)                       00004940
                 C                                                                      00004950
                 C.... THIS ROUTINE COMPUTES THE CONCENTRATION FIELDS.                  00004960
                 C                                                                      00004970
  ISN 0003             DIMENSION CP1(IM,JM,KM), C(IM,JM,KM),CC(IM,JM),COLD(IM,JM)       00004980
                     *    ,U(IM,JM,KN),V(IM,JM,KN),W(IM,JM,KN)                          00004990
                     *    ,ZS(IM,JM),QA(IM,JM),AKZ(IM,JM)                               00005000
                     *    ,DX(IM),RDX(IM),DXS(IM),DY(JM),RDY(JM),DYS(JM),EK(LM),FK(LM)  00005010
                     *    ,DZ(KM),RDZ(KM),DZS(KM),Z(KM),ZM(KM),AKH(KM)                  00005020
                     &    ,AKF(KM),UZF(KM),VZF(KM),WZF(KM), XPUTM(LM),YPUTM(LM)         00005030
                     *    ,XP(LM),YP(LM),ZP(LM),PQA(LM),ZR(LM),ZPR(LM),AKA(24)          00005040
                 C                                                                      00005050
  ISN 0004             COMMON    /AADATA/                                               00005060
                     *    IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW          00005070
                     *   ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC     00005080
                     *   ,LPRINT,LTSTOP,LTSOUS,LTWIND                                   00005090
                     *   ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00005100
                     *   ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN             00005110
                     *   ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ      00005120
                 C                                                                      00005130
                 C *** STORE OLD SURFACE C ***                                          00005140
                 C                                                                      00005150
  ISN 0005             CALL        SHIFTN      (CP1,COLD,IM,JM,KM,IM,JM, 1)             00005160
                 C                                                                      00005170
                 C ***  ADD SOURCES ***                                                 00005180
                 C                                                                      00005190
  ISN 0006             CALL        SHIFTN      (CP1,    C,IM,JM,KM,IM,JM,KM)            00005200
                 C                                                                      00005210
  ISN 0007             CALL        SOURCE                                               00005220
                     & (CP1, C,QA,QA,ZS,PQA,PQA,XPUTM,YPUTM,XP,YP,ZP,ZR,ZPR,U,V,UZF,VZF 00005230
                     & ,AKF,AKH,AKZ,DX,DY,DZ,Z,EK,FK,IM,JM,KM,KN,IMJM,LM)               00005240
                 C                                                                      00005250
                 C *** CALCULATE HORIZONTAL ADVECTION ***                               00005260
                 C                                                                      00005270
  ISN 0008             CALL        SHIFTN      (CP1,    C,IM,JM,KM,IM,JM,KM)            00005280
                 C                                                                      00005290
  ISN 0009             CALL        UVFLUX                                               00005300
                     & (CP1, C,U,UZF,DX,DY,RDX,RDY,Z,EK,FK                              00005310
                     & ,IM,JM,KM,IMJM,IJKM, 1,IM,IJKN)                                  00005320
                 C                                                                      00005330
  ISN 0010             CALL        SHIFTN      (CP1,    C,IM,JM,KM,IM,JM,KM)            00005340
                 C                                                                      00005350
  ISN 0011             CALL        UVFLUX                                               00005360
                     & (CP1, C,V,VZF,DY,DX,RDY,RDX,Z,EK,FK                              00005370
                     & ,JM,IM,KM,IMJM,IJKM,IM, 1,IJKN)                                  00005380
                 C                                                                      00005390
                 C *** CALCULATE VERTICAL ADVECTION ***                                 00005400
                 C                                                                      00005410
  ISN 0012             CALL        SHIFTN      (CP1,    C,IM,JM,KM,IM,JM,KM)            00005420
                 C                                                                      00005430
  ISN 0013             IF (LWW .NE. 0)     CALL        WWFLUX                           00005440
                     & (CP1, C,W,WZF, Z,DX,DY,DZ,EK,FK,RDX,RDY,RDZ                      00005450
                  & ,IM,JM,KM,IMJM,IJKM,IJKN)
             C
             C *** CALCULATE HORIZONTAL DIFFUSION ***
             C
ISN 0015            IF (LWW.NE.0)     CALL        SHIFTN     (CP1, C,IM,JM,KM,IM,JM,KM)
             C
ISN 0017            CALL        XYDIFF
                  & (CP1,  C,AKM,AKZ,AKF,RDX,RDY,DXS,DYS,IM,JM,KM,IMJM,IJKM)
             C
             C *** CALCULATE VERTICAL DIFFUSION ***
             C
ISN 0018            CALL        SHIFTN     (CP1,   C,IM,JM,KM,IM,JM,KM)
             C
ISN 0019            CALL        ZZDIFF
                  & (CP1, C,AKZ,AKF,RDZ,DZS,ZM,EK,FK,IM,JM,KM,IMJM,IJKM)
             C
             C *** CALCULATE CHEMICAL DECAY ***
             C
ISN 0020            CALL        SHIFTN     (CP1,   C,IM,JM,KM,IM,JM,KM)
             C
ISN 0021            IF (LCHEM .NE. 0)     CALL        CHEMIC
                  & (CP1,C,IM,JM,KM,IMJM,IJKM,AKA)
             C
ISN 0023            IF (LCHEM.NE.0)     CALL      SHIFTN     (CP1,C,IM,JM,KM,IM,JM,KM)
             C
ISN 0025            IF  (ITSEC .LT. 900) GO TO 100
             C
             C *** CHECK IF STEADY STATE SOLUTION HAVE BEEN OBTAINED ***
             C
ISN 0027            ICHECK=0
             C
ISN 0028            CALL        CCHECK     (CP1,COLD,IJKM,IMJM,ICHECK,DCMIN)
             C
ISN 0029            IF (ICHECK .EQ. 1) GO TO 100
             C
             C...   STEADY STATE REACHED .....
ISN 0031            DT=LPRINT-TSEC
ISN 0032        100 CONTINUE
             C
             C *** TAKE TIME AVERAGE CC ***
             C
ISN 0033            DTPRNT=DT/LPRINT
ISN 0034            DO 200 J=1,JM
ISN 0035            DO 200 I=1,IM
ISN 0036            CC(I,J)=CC(I,J)+CP1(I,J,1)*DTPRNT
ISN 0037        200 CONTINUE
             C
ISN 0038            RETURN
             C      DEBUG SUBCHK
ISN 0039            END
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       38 ,PROGRAM SIZE =     3162

*STATISTICS*  NO  DIAGNOSTICS GENERATED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                    C                                                                          00000010
  ISN 0002                SUBROUTINE AKZCAL (AKZ, U, V, Z0,AKF,AKH,ZM,IMJM,IJKM,KM)            00000020
                    C                                                                          00000030
                    C.... IT ESTIMATES THE EDDY AKZ FROM SURFACE WIND SPEED & OBUKHOV-MONIN     00000040
                    C     LENTH WHICH IS CALCULATED FROM THE STABILITY  INDEX AND ROUGHNESS    00000050
                    C     BY THE FOLLOWING FORMULAS:                                           00000060
                    C     1) 1/L=SIGN(S)*10**(-4/(1+1.3*S**0.85))/((0.216586*LOG(1.2+10/Z0))00000070
                    C              **2).                                                       00000080
                    C     2) U0=UV*AK/HFZ, HFZ=INTEG(NON-DIM. WIND SHEAR).                     00000090
                    C     3) AKZ(Z)= U0*AK=Z/PHIFHZ, PHIFHZ=NON-DIM. TEMP GRADIENT             00000100
                    C     AKZ   = EDDY DIFFUSIVITY                                             00000110
                    C     U,V   = SURFACE WIND                                                 00000120
                    C     Z0    = SURFACE ROUGHNESS                                            00000130
                    C     OLMIN = MIN. OF OBUKHOV LENGTH                                       00000140
                    C     HH    = HEIGHT OF MIXING LAYER                                       00000150
                    C     OL    = OBUKHOV-MONIN KENGTH                                         00000160
                    C     S     = STABILITY INDEX                                              00000170
                    C                                                                          00000180
  ISN 0003                DIMENSION   AKZ(IMJM),U(IJKM),V(IJKM),Z0(IMJM),AKF(KM),ZM(KM)        00000190
                         *              ,AKH(KM)                                               00000200
                    C                                                                          00000210
  ISN 0004                COMMON    /AADATA/                                                   00000220
                         *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW              00000230
                         *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC         00000240
                         *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                       00000250
                         *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM    00000260
                         *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,OCMIN                 00000270
                         *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ          00000280
                    C                                                                          00000290
  ISN 0005                DATA PAI/3.14159/                                                    00000300
                    C                                                                          00000310
                    C *** COMPUTE BULK RICHARDSON NUMBER ***                                   00000320
                    C      (CURRENT-- FOR REFERENCE ONLY)                                      00000330
  ISN 0006                RIB=0.0                                                              00000340
                    C     TAVE=0.5*(PARM(3)+PARM(8)+273.16                                     00000350
                    C     GZT=9.8016*HS*HS/TAVE                                                00000360
                    C     DTDZ=(PARM(8)-PARM(3)/(30.-HS)+0.00976                               00000370
                    C     RIB=GZT*DTDZ/(PARM(1)*PARM(1))                                       00000380
                    C                                                                          00000390
  ISN 0007                S=PARM(4)                                                            00000400
  ISN 0008                SIGNS=1.0                                                            00000410
  ISN 0009                IF ( S .LT. 0.0) SIGNS=-1.0                                          00000420
  ISN 0011                SS=  ABS(S)                                                          00000430
  ISN 0012                O1=10.0**(-4.0/(1.0+1.3*SS**0.85))                                   00000440
  ISN 0013                Z=HS                                                                 00000450
  ISN 0014                DO 200 I=1,IMJM                                                      00000460
  ISN 0015                Z00=Z0(I)                                                            00000470
  ISN 0016                OLI=O1*(0.216586* ALOG(1.2+10./Z00))**2                              00000480
  ISN 0017                OL=SIGNS/OLI                                                         00000490
                    C.... MIN. OF OL IS SPECIFIED TO AVOID TOO SMALL VALUES OF OL              00000500
  ISN 0018                IF ( ABS(OL) .LT. OLMIN) OL= SIGN (OLMIN,OL)                         00000510
  ISN 0020                UV= SQRT( U(I)**2+V(I)**2)                                           00000520
  ISN 0021                ZOL=Z/OL                                                             00000530
  ISN 0022                AZOL=A1(1)*ZOL                                                       00000540
                    C                                                                          00000550
                    C *** BUSINGER'S FORMULAS TO ESTIMATE EDDY AKZ ****                        00000560
```

```
                C                                                                        00000570
  ISN 0023            IF (OL .LT. 0.0) GO TO 100                                         00000580
                C                                                                        00000590
                C.... STABLE CASE ....                                                   00000600
  ISN 0025            PHIFZ=1.0+AZOL                                                     00000610
  ISN 0026            PHIFMZ=A1(4)+AZOL                                                  00000620
  ISN 0027            HFZ= ALOG(1.0+Z/Z00)+AZOL                                          00000630
  ISN 0028            GO TO 120                                                          00000640
                C                                                                        00000650
                C.... UNSTABLE CASE ......                                               00000660
  ISN 0029        100 CONTINUE                                                           00000670
  ISN 0030            PHIFZ=(1.0-A1(2)*ZOL)**(-0.25)                                     00000680
  ISN 0031            PHIFMZ= A1(4)*(1.0-A1(3)*ZOL)**(-0.5)                              00000690
  ISN 0032            X=1.0/PHIFZ                                                        00000700
  ISN 0033            XA= 2.0*ALOG(0.5*(1.0+X))                                          00000710
  ISN 0034            XB= ALOG(0.5*(1.0+X*X))                                            00000720
  ISN 0035            XC= 2.0*ATAN( X)                                                   00000730
  ISN 0036            HFZ= ALOG(1.0+Z/Z00)-XA-XB+XC-0.5*PAI                              00000740
  ISN 0037        120 CONTINUE                                                           00000750
  ISN 0038            U0=UV*AK/HFZ                                                       00000760
  ISN 0039            AKZ(I)= U0*AK*Z/PHIFMZ                                             00000770
  ISN 0040        200 CONTINUE                                                           00000780
                C                                                                        00000790
  ISN 0041            PARM(10)=OL                                                        00000800
                C                                                                        00000810
                C *** COMPUTE K AT HIGHER HEIGHT ***                                     00000820
                C                                                                        00000830
                C     AKZF=K(Z)/K(HS) IS THE RATIO OF TWO K AT TWO HEIGHTS WHICH         00000840
                C     IS SUBJECTED TO IMPROVEMENT BY INCORPORATING THE INTERNAL          00000850
                C     TURBULENCE BOUNDRY LAYER DUE TO HORIZONTAL INHOMOGENEITY....       00000860
                C                                                                        00000870
  ISN 0042            HH=PARM(5)                                                         00000880
                C                                                                        00000890
  ISN 0043            DO 400 K=1,KM                                                      00000900
                C.... LIMIT THE HEIGHT BETWEEN ZMAX AND HS.                              00000910
  ISN 0044            ZZ=ZM(K)                                                           00000920
  ISN 0045            IF ( ZM(K).LT. 20) ZZ=20.                                          00000930
  ISN 0047            IF (ZM(K).GT. ZMAX) ZZ=ZMAX                                        00000940
  ISN 0049            AKZF=ZZ/HS*EXP(-0.004*(ZZ-HS))                                     00000950
                C     AKZF=0.5 WHEN ZM(K) IS ABOVE MIXING HEIGHT OR AKZF IS TOO SMALL.   00000960
  ISN 0050            IF ((ZM(K).GT. HH) .OR.   (AKZF .LT. 0.5)) AKZF=0.5                00000970
  ISN 0052            AKF(K)=AKZF                                                        00000980
  ISN 0053        400 CONTINUE                                                           00000990
                C                                                                        00001000
  ISN 0054            RETURN                                                             00001010
                C     DEBUG SUBCHK                                                       00001020
  ISN 0055            END                                                                00001030
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      54 ,PROGRAM SIZE =      1670

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                       113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C
  ISN 0002              SUBROUTINE CADJUS (CP1,C,RDZ,IM,JM,KM,IMJM,IJKM,KNN,RH,LHJUS)
                  C
                  C.... THIS SUBROUTINE ADJUST THE CONCENTRATION VALUES DUE TO CHANGE
                  C      IN VOLUME OF GRID CELLS.
                  C.... RH    = RATIO OF OLD TO NEW VERTICAL GRID SIZE
                  C     IRH   = MIN. OF (RH+1,2), =1, IF (RH.LE.1); =2, IF (RH.GT.1)
                  C     LHJUS= CONTROL FLAG TO DECIDE WHICH METHOD TO ADJUST THE CONC.
                  C             VALUE DUE TO GRID CHANGE
                  C          ---------------------- METHOD -------------------------
                  C             LHJUS =        0       1       2       3
                  C     IRH = 1                A       A       C       C
                  C     IRH = 2                A       B       A       B
                  C                     -------------------------------
                  C     METHOD A : KEEP THE TOTAL MASS CONSTANT
                  C     METHOD B : STRETCH GRID SPACE BUT KEEP OLD CONC. VALUE
                  C                 (USED ONLY WHEN RH.GE.1 -- RISING MIXING HEIGHT)
                  C     METHOD C : COMPRESS GRID SPACE WHILE OBTAIN THE NEW CONC. VALUE
                  C                AT CORRESPONDING HEIGHT OF OLD CONC. PROFILE
                  C                 (USED ONLY WHEN RH.LT.1 -- LOWERING MIXING HEIGHT)
                  C
  ISN 0003              DIMENSION CP1(IJKM),C(IJKM),RDZ(KM),LHH(2)
                  C
  ISN 0004              IF ( RH .LE. 0.0) RETURN
                  C
                  C.... FIX CONTROL PARAMETERS
  ISN 0006              LH=LHJUS
  ISN 0007              IRH=RH+1
  ISN 0008              IF ( IRH .GT. 2) IRH=2
  ISN 0010              LHH(1)=LH/2
  ISN 0011              LHH(2)=LH-(LH/2)*2
  ISN 0012              IF ( LHH(IRH) .EQ. 1) GO TO 200
                  C
                  C *** DILUTION (METHOD A) ***
                  C.... RFRH IS DILUTION FACTOR.
  ISN 0014              KK=(KNN-2)*IMJM
  ISN 0015              RF=(RH+RDZ(KNN))/(1.0+RDZ(KNN))
  ISN 0016              DO 100 K=KNN,KM
  ISN 0017              IF ( K .GT. KNN) RF=1.0
  ISN 0019              RFRH=RF/RH
  ISN 0020              KK=KK+IMJM
  ISN 0021              DO 100 I=1,IMJM
  ISN 0022              IJK=I+KK
  ISN 0023              CP1(IJK)= C(IJK) *RFRH
  ISN 0024          100 CONTINUE
                  C
  ISN 0025              RETURN
                  C
                  C *** MOVE GRID POINTS (METHOD B & C) ***
                  C.... METHOD B -- RETURN TO MAIN PROGRAM
                  C      THIS METHOD IS AUTOMATIC WHEN ROUTINE DIMEN1 IS CALLED
  ISN 0026          200 CONTINUE
  ISN 0027              IF ( RH .GE. 1.0) RETURN
                  C
                  C.... METHOD C -- THIS PART OF PROGRAM IS REACHED ONLY WHEN LHH=1
                  C                 AND RH.LT.1 (GRID POINT IS COMPRESSED)
```

```
   ISN 0029            KNN1=KNN+1                                                00001600
   ISN 0030            KK=IJKM                                                   00001610
   ISN 0031            DO 300 L=KNN1,KM                                          00001620
   ISN 0032            KK=KK-IMJM                                                00001630
   ISN 0033            K=KM-L+KNN1                                               00001640
   ISN 0034            RHK= ( K-KNN)*RH                                          00001650
   ISN 0035            KRM=RHK                                                   00001660
   ISN 0036            RR=1.0-RHK+KRM                                            00001670
   ISN 0037            KKK=(KNN+KRM)*IMJM                                        00001680
   ISN 0038            DO 300 I=1,IMJM                                           00001690
   ISN 0039            IJKK=KKK+I                                                00001700
   ISN 0040            IJK=I+KK                                                  00001710
   ISN 0041            CP1(IJK)= (1.0-RR)*C(IJKK)+RR*C(IJKK-IMJM)                00001720
   ISN 0042        300 CONTINUE                                                  00001730
                 C                                                               00001740
   ISN 0043            RETURN                                                    00001750
                 C     DEBUG SUBCHK                                              00001760
   ISN 0044            END                                                       00001770
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       43 ,PROGRAM SIZE =      1016

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                     117K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                           OS/360  FORTRAN H

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                            SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
               C                                                                  00001780
  ISN 0002           SUBROUTINE CCHECK ( CP1,COLD,IJKM,IMJM,ICHECK,DCMIN)         00001790
               C                                                                  00001800
               C.... THIS SUBROUTINE CHECKS IF CONCENTRATION REACH THE STEADY STATE 00001810
               C....  VALUE. IF YES, ICHECK=0, OTHERWISE ICHECK=1.                 00001820
               C.... DCMIN IS A SPECIFIED NUMBER INPUT BY NAMELIST/INLIST/         00001830
               C                                                                  00001840
  ISN 0003           DIMENSION CP1(IJKM),COLD(IMJM)                               00001850
               C                                                                  00001860
  ISN 0004           DO 100 I=1,IMJM                                              00001870
  ISN 0005           DC= CP1(I)-COLD(I)                                           00001880
  ISN 0006           IF (ABS(DC) .LE. DCMIN) GO TO 100                            00001890
  ISN 0008           ICHECK=1                                                     00001900
  ISN 0009       100 CONTINUE                                                     00001910
               C                                                                  00001920
  ISN 0010           RETURN                                                       00001930
               C     DEBUG SUBCHK                                                 00001940
  ISN 0011           END                                                          00001950

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       10 ,PROGRAM SIZE =      380

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                              125K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                    OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                      C                                                                   00001960
   ISN 0002                SUBROUTINE CHEMIC (CP1,C,IM,JM,KM,IMJM,IJKM,AKA)             00001970
                      C                                                                   00001980
                      C.... THIS SUBROUTINE COMPUTES CHEMICAL DECAY OF SO2.               00001990
                      C.... AKA IS REACTION RATE CONSTANT.                                00002000
                      C                                                                   00002010
   ISN 0003                DIMENSION CP1(IJKM), C(IJKM),  AKA(24)                        00002020
                      C                                                                   00002030
   ISN 0004                COMMON    /AADATA/                                             00002040
                          *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW       00002050
                          *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC  00002060
                          *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                 00002070
                          *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00002080
                          *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,OCMIN           00002090
                          *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,GBTOT,PQBTOT,UO,PHIFMZ,HFZ     00002100
                      C                                                                   00002110
   ISN 0005                IHR1=IHR+1                                                     00002120
   ISN 0006                IF ( IHR1 .GT. 24) IHR1=1                                      00002130
   ISN 0008                DTAKA=DT*AKA(IHR1)                                             00002140
   ISN 0009                KK=-IMJM                                                       00002150
   ISN 0010                DO 100 K=1,KM                                                  00002160
   ISN 0011                KK=KK+IMJM                                                     00002170
   ISN 0012                JJ=-IM                                                         00002180
   ISN 0013                DO 100 J=1,JM                                                  00002190
   ISN 0014                JJ=JJ+IM                                                       00002200
   ISN 0015                DO 100 I=1,IM                                                  00002210
   ISN 0016                IJK=I+JJ+KK                                                    00002220
   ISN 0017                CP1(IJK)= CP1(IJK) -DTAKA*C(IJK)                               00002230
   ISN 0018            100 CONTINUE                                                       00002240
                      C                                                                   00002250
   ISN 0019                RETURN                                                         00002260
                      C    DEBUG SUBCHK                                                   00002270
   ISN 0020                END                                                            00002280
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      19 ,PROGRAM SIZE =      536

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                    121K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                              OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                 C                                                                      00002290
  ISN 0002             SUBROUTINE CONSIN (IM,JM,KM,KN,IMJM,IJKM,IJKN)                   00002300
                 C                                                                      00002310
                 C.... THIS SUBROUTINE SPECIFY VALUE OF CONSTANTS.                      00002320
                 C                                                                      00002330
  ISN 0003             DIMENSION CARD(20)                                               00002340
                 C                                                                      00002350
  ISN 0004             COMMON    /AADATA/                                               00002360
                     *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW           00002370
                     *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC      00002380
                     *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                    00002390
                     *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00002400
                     *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN              00002410
                     *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UC,PHIFHZ,HFZ      00002420
                 C                                                                      00002430
  ISN 0005             AK=0.35                                                          00002440
  ISN 0006             A1(1)=4.7                                                        00002450
  ISN 0007             A1(2)=15.0                                                       00002460
  ISN 0008             A1(3)=9.0                                                        00002470
  ISN 0009             A1(4)=0.74                                                       00002480
  ISN 0010             ITMHR=0                                                          00002490
  ISN 0011             ITOTHR=0                                                         00002500
  ISN 0012             ITSTEP=0                                                         00002510
  ISN 0013             TSEC=0.                                                          00002520
  ISN 0014             ITSEC=TSEC                                                       00002530
  ISN 0015             ITM=TM                                                           00002540
  ISN 0016             IM1=IM-1                                                         00002550
  ISN 0017             JM1=JM-1                                                         00002560
  ISN 0018             KM1=KM-1                                                         00002570
  ISN 0019             IMJM=IM*JM                                                       00002580
  ISN 0020             IJKM=IM*JM*KM                                                    00002590
  ISN 0021             IJKN=IM*JM*KN                                                    00002600
  ISN 0022             LPRINT=3600                                                      00002610
  ISN 0023             IF (LPRINT .GT. LTSOUS) LPRINT=LTSOUS                            00002620
  ISN 0025             IF (LPRINT .GT. LTWIND) LPRINT=LTWIND                            00002630
                 C                                                                      00002640
  ISN 0027             RETURN                                                           00002650
                 C                                                                      00002660
                 C     -------------------------------------------------------.         00002670
                 C                                                                      00002680
  ISN 0028             ENTRY CDTOTP (JUNIT1,IUNIT1,IUNIT2)                              00002690
                 C                                                                      00002700
                 C *** PRINT CARD IMAGES OF NAMELIST ***                                00002710
                 C     IUNIT1=UNIT FOR CARD READER,IUNIT2=TEMPORARY DISK,JUNIT1=PRINTER..00002720
                 C                                                                      00002730
  ISN 0029             WRITE (JUNIT1, 5)                                                00002740
  ISN 0030           5 FORMAT ('1')                                                     00002750
  ISN 0031          10 READ (IUNIT1, 20, END = 100) (CARD(I), I = 1, 20, 1)             00002760
  ISN 0032          20 FORMAT (20A4)                                                    00002770
  ISN 0033             WRITE (IUNIT2, 20) (CARD(I), I = 1, 20, 1)                       00002780
  ISN 0034             WRITE ( JUNIT1, 30) (CARD(I), I = 1, 20, 1)                      00002790
  ISN 0035          30 FORMAT (10X, 20A4)                                               00002800
  ISN 0036             GO TO 10                                                         00002810
  ISN 0037         100 END FILE IUNIT2                                                  00002820
  ISN 0038             REWIND IUNIT2                                                    00002830
  ISN 0039             WRITE (JUNIT1, 200)                                              00002840
```

```
   ISN 0040        200 FORMAT ('0   CARDS COPIED TO DISK.')                                               00002850
                 C                                                                                        00002860
   ISN 0041            RETURN                                                                             00002870
                 C     DEBUG SURCHK                                                                       00002880
   ISN 0042            END                                                                                00002890
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      41 ,PROGRAM SIZE =     1076

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                          117K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                              SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                    00002900
  ISN 0002              SUBROUTINE DIMENS (DX,DY,DZ,RDX,RDY,RDZ,DXS,DYS,DZS,Z,ZM,      00002910
                       *   IM,JM,KM)                                                   00002920
                  C                                                                    00002930
                  C.... THIS SUBROUTINE COMPUTES NECESSARY CONSTANT PARAMETERS FOR     00002940
                  C      NUMERICAL GRID SYSTEM EITHER CONSTANT OR VARIABLE GRID ...    00002950
                  C.... THE ROUTINE IS CALLED IN TWO WAYS. DIMENS FOR INITIALIZATION;  00002960
                  C....  DIMEN1 FOR EVERY HOUR WHEN MIXING HEIGHT IS CHANGED.          00002970
                  C                                                                    00002980
  ISN 0003              DIMENSION                                                      00002990
                       *    DX(IM),RDX(IM),DXS(IM),DY(JM),RDY(JM),DYS(JM)              00003000
                       *   ,DZ(KM),RDZ(KM),DZS(KM),Z(KM),ZM(KM)                        00003010
                  C                                                                    00003020
  ISN 0004              COMMON    /AADATA/                                             00003030
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW        00003040
                       *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC   00003050
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                 00003060
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00003070
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN           00003080
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UC,PHIFHZ,HFZ    00003090
                  C                                                                    00003100
                  C *** INITIALIZE NUMERICAL GRID SYSTEM ***                           00003110
                  C                                                                    00003120
                  C ... DXS=DX**2,PDX=RATIO OF VARIABLE GRID ,Z=ACTUAL HEIGHT           00003130
                  C     ZM=MIDDLE POINT OF GRID                                        00003140
                  C                                                                    00003150
                  C.... GRID IN X-DIRECTION                                            00003160
  ISN 0005              DO 40 I=1,IM1                                                  00003170
  ISN 0006              DXS(I)= DX(I)*DX(I)                                            00003180
  ISN 0007              RDX(I+1)= DX(I+1)/DX(I)                                        00003190
  ISN 0008           40 CONTINUE                                                       00003200
  ISN 0009              RDX(1)=1.0                                                     00003210
  ISN 0010              DXS(IM)=DX(IM)*DX(IM)                                          00003220
                  C                                                                    00003230
                  C.... GRID IN Y-DIRECTION                                            00003240
  ISN 0011              DO 50 J=1,JM1                                                  00003250
  ISN 0012              RDY(J+1)= DY(J+1)/DY(J)                                        00003260
  ISN 0013              DYS(J)= DY(J)*DY(J)                                            00003270
  ISN 0014           50 CONTINUE                                                       00003280
  ISN 0015              RDY(1)=1.0                                                     00003290
  ISN 0016              DYS(JM)=DY(JM)*DY(JM)                                          00003300
                  C                                                                    00003310
                  C.... GRID IN Z-DIRECTION                                            00003320
  ISN 0017              DO 60 K=1,KM1                                                  00003330
  ISN 0018              RDZ(K+1)= DZ(K+1)/DZ(K)                                        00003340
  ISN 0019              DZS(K+1)= 0.5*DZ(K+1)*(DZ(K+1)+DZ(K))                          00003350
  ISN 0020           60 CONTINUE                                                       00003360
  ISN 0021              DZS(1)= DZ(1)*DZ(1)                                            00003370
  ISN 0022              RDZ(1)= 1.0                                                    00003380
  ISN 0023              DZS(KM)= DZ(KM)*DZ(KM)                                         00003390
                  C                                                                    00003400
                  C.... GRID HEIGHT                                                    00003410
  ISN 0024              Z(1)=0.0                                                       00003420
  ISN 0025              ZM(1)= 0.5*DZ(1)                                               00003430
  ISN 0026              DO 70 K=2,KM                                                   00003440
  ISN 0027              Z (K)= Z(K-1)+DZ(K-1)                                          00003450
```

```
      ISN 0028            ZM(K)= 0.5*(DZ(K)+DZ(K-1))+ ZM(K-1)                      00003460
      ISN 0029         70 CONTINUE                                                  00003470
      ISN 0030            IF (Z(KM) .GT. HG) HG=Z(KM)                               00003480
      ISN 0032            HH=HG                                                     00003490
      ISN 0033            PARM(5)=HH                                                00003500
                    C                                                               00003510
      ISN 0034            RETURN                                                    00003520
                    C                                                               00003530
                    C     ------------------------------------------------------    00003540
                    C                                                               00003550
      ISN 0035            ENTRY DIMEN1 (DZ,RDZ,DZS,Z,ZM,KM,KNN,RH)                  00003560
                    C                                                               00003570
                    C *** CHANGE VERTICAL GRID DUF TO CHANGE IN MIXING HEIGHT ***    00003580
                    C.... HH IS MIXING HEIGHT. RH IS RATIO OF NEW DZ TO OLD DZ.     00003590
                    C     THE FIRST 9 GRIDS ARE FIXED,AND 4 TOP GRIDS VARY          00003600
                    C     IF HH LESS THAN 300 M, Z(JM) IS KEPT AT 300M              00003610
                    C     BUT THE EFFECTS OF INVERSION IS IN THROUGH DIMINISH THE EDDY K 00003620
                    C                                                               00003630
      ISN 0036            HH=PARM(5)                                                00003640
      ISN 0037            DZKM=DZ(KM)                                               00003650
      ISN 0038            DZT=0.25*(HH-Z(KNN))                                      00003660
      ISN 0039            IF ( DZT .LT. DZ(KNN-1)) DZT=DZ(KNN-1)                    00003670
                    C                                                               00003680
      ISN 0041            DO 100 K=KNN,KM                                           00003690
      ISN 0042            DZ(K)= DZT                                                00003700
      ISN 0043            RDZ(K)= DZ(K)/DZ(K-1)                                     00003710
      ISN 0044            Z(K)= Z(K-1)+DZ(K-1)                                      00003720
      ISN 0045            ZM(K)= Z(K)+0.5*DZ(K)                                     00003730
      ISN 0046            DZS(K)= 0.5*DZ(K)*(DZ(K)+DZ(K-1))                         00003740
      ISN 0047        100 CONTINUE                                                  00003750
                    C                                                               00003760
                    C.... COMPUTE RATIO OF NEW &OLD VERTICAL GRID                   00003770
      ISN 0048            RH=DZ(KM)/DZKM                                            00003780
      ISN 0049            IF (ITM .EQ. 0) RH=1.0                                    00003790
                    C                                                               00003800
      ISN 0051            RETURN                                                    00003810
                    C                                                               00003820
                    C     -----------------------------------------------------.    00003830
                    C                                                               00003840
      ISN 0052            ENTRY       HHCALC      (HH,HMIN,HMAX)                    00003850
                    C                                                               00003860
                    C.... CALCULATE MIXING HEIGHT HH AS FUNCTION OF (IHR,HMIN,HMAX). 00003870
                    C                                                               00003880
      ISN 0053            IF (IHR .LE. 5) HH=HMIN                                   00003890
      ISN 0055            IF((IHR.GE.6).AND.(IHR.LE.13))HH=HMIN+(HMAX-HMIN)*(IHR-5.5)/8. 00003900
      ISN 0057            IF((IHR.GE.14).AND.(IHR.LE.17)) HH=HMAX                   00003910
      ISN 0059            IF(IHR.GE.18)HH=HMAX+(HMIN-HMAX)*(IHR-17.5)/6.            00003920
                    C                                                               00003930
      ISN 0061            RETURN                                                    00003940
                    C     DEBUG SUBCHK                                              00003950
      ISN 0062            END                                                       00003960
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      61 ,PROGRAM SIZE =     2160

*STATISTICS*  NO  DIAGNOSTICS GENERATED
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LEVEL 21.6 ( MAY 72 )                           OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                          SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                00003970
  ISN 0002              SUBROUTINE      DTTEST                                     00003980
                       * (U,V,AKH,AKZ,AKF,AKAHR,UZF,VZF,DX,DY,Z,IM,JM,KM,IMJM,IJKN,KN)   00003990
                  C                                                                00004000
                  C.... THIS SUBROUTINE COMPUTES AND CHECK TIME STEP FOR NUMERICAL  00004010
                  C       STABILITY CRITERIA.                                      00004020
                  C                                                                00004030
  ISN 0003              DIMENSION                                                  00004040
                       *  U(IJKN),V(IJKN),DX(IM),DY(JM),Z(KM),AKH(KM),UZF(KM),VZF(KM)    00004050
                       *  ,AKZ(IMJM),AKF(KM)                                       00004060
                  C                                                                00004070
  ISN 0004              COMMON    /AADATA/                                         00004080
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW    00004090
                       *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC     00004100
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                             00004110
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00004120
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,DLMIN,DCMIN       00004130
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ      00004140
                  C                                                                00004150
  ISN 0005              DATA THR/3600./                                            00004160
                  C                                                                00004170
  ISN 0006              LX=1                                                       00004180
  ISN 0007              LY=IM                                                      00004190
  ISN 0008              DTI= 1.0/THR                                               00004200
  ISN 0009              KKMAX=(KN-1)*IMJM                                          00004210
  ISN 0010              KK=-IMJM                                                   00004220
  ISN 0011              KNMAX=KM                                                   00004230
  ISN 0012              IF( KN .GT. 1) KNMAX=KN                                    00004240
  ISN 0014              DO 120 K=1,KNMAX                                           00004250
  ISN 0015              KK=KK+ IMJM                                                00004260
  ISN 0016              IF (KK .GT. KKMAX) KK=KKMAX                                00004270
  ISN 0018              JJ=-IM                                                     00004280
  ISN 0019              DO 110 J=1,JM1                                             00004290
  ISN 0020              JJ=JJ+ IM                                                  00004300
  ISN 0021              DO 100 I=1,IM1                                             00004310
  ISN 0022              IJ= I+JJ                                                   00004320
  ISN 0023              IJK = IJ+KK                                                00004330
  ISN 0024              DTU= U(IJK)*UZF(K)/DX(I)                                   00004340
  ISN 0025              DTV= V(IJK)*VZF(K)/DY(J)                                   00004350
  ISN 0026              DTU= ABS(DTU)                                              00004360
  ISN 0027              DTV= ABS(DTV)                                              00004370
  ISN 0028              DTI   = AMAX1 (DTU, DTV, DTI)                              00004380
  ISN 0029          100 CONTINUE                                                   00004390
  ISN 0030          110 CONTINUE                                                   00004400
  ISN 0031          120 CONTINUE                                                   00004410
  ISN 0032              DTIAKH=DTI                                                 00004420
                  C                                                                00004430
  ISN 0033              DYMIN=DY(1)                                                00004440
  ISN 0034              DXMIN=DX(1)                                                00004450
  ISN 0035              DO 210 I=2,IM                                              00004460
  ISN 0036          210 IF (DXMIN .GT. DX(I)) DXMIN=DX(I)                          00004470
  ISN 0038              DO 220 J=2,JM                                              00004480
  ISN 0039          220 IF (DYMIN .GT. DY(J)) DYMIN=DY(J)                          00004490
  ISN 0041              DXYMIN=DXMIN                                               00004500
  ISN 0042              IF(DXYMIN .GT. DYMIN) DXYMIN=DYMIN                         00004510
                  C                                                                00004520
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   ISN 0044             AKHMAX=AKH(1)                                                 00004530
   ISN 0045             AKFMAX=AKF(1)                                                 00004540
   ISN 0046             DO 300 K=2,KM                                                 00004550
   ISN 0047             IF(AKFMAX .LT. AKF(K)) AKFMAX=AKF(K)                          00004560
   ISN 0049             IF(AKHMAX .LT. AKH(K)) AKHMAX=AKH(K)                          00004570
   ISN 0051         300 CONTINUE                                                      00004580
   ISN 0052             AKHDXY=4.0*AKHMAX*AKFMAX/(DXYMIN**2)                          00004590
   ISN 0053             AKZMAX=AKZ(1)                                                 00004600
   ISN 0054             DO 320 I=2,IMJM                                               00004610
   ISN 0055             IF(AKZMAX .LT. AKZ(I)) AKZMAX=AKZ(I)                          00004620
   ISN 0057         320 CONTINUE                                                      00004630
                  C                                                                   00004640
   ISN 0058             DTIAKH=AKHDXY*AKZMAX                                          00004650
   ISN 0059             DTIAKA=AKAHR                                                  00004660
   ISN 0060             DTI=AMAX1(DTI,DTIAKH,DTIAKA)                                  00004670
                  C                                                                   00004680
   ISN 0061             IF ( DTI .LE.  0.0) DTI= 1.0                                  00004690
   ISN 0063             IDT= 1.0/DTI                                                  00004700
   ISN 0064             IF ( IDT .LT. 1) IDT=1                                        00004710
   ISN 0066             IDTOT=THR                                                     00004720
                  C                                                                   00004730
                  C.... CHOOSE DT SUCH THAT THR IS MULTIPLE OF DT                     00004740
   ISN 0067             NDT= IDTOT/IDT                                                00004750
   ISN 0068         400 IF ((NDT*IDT) .GE. IDTOT)  GO TO 420                          00004760
   ISN 0070         410 IDT= IDT-1                                                    00004770
   ISN 0071             NDT= IDTOT/IDT                                                00004780
   ISN 0072             GO TO 400                                                     00004790
   ISN 0073         420 CONTINUE                                                      00004800
   ISN 0074             DT=IDT                                                        00004810
   ISN 0075             ITT=TM/IDTOT                                                  00004820
   ISN 0076             TI=TM-ITT*IDTOT                                               00004830
   ISN 0077             DTLAST=IDTOT-TI                                               00004840
   ISN 0078             IF (DT .GT. DTLAST) DT=DTLAST                                 00004850
                  C                                                                   00004860
   ISN 0080             RETURN                                                        00004870
                  C     DEBUG SUBCHK                                                  00004880
   ISN 0081             END                                                           00004890

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       80 ,PROGRAM SIZE =      1866

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                     109K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                        OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                    00004900
  ISN 0002              SUBROUTINE       GEOIN                                         00004910
                       &(QB,ZS,Z0,PQB,XPUTM,YPUTM,XP,YP,ZP,ZR,NP,IUTM,JUTM,DX,DY,IM,JM 00004920
                       & ,LM,LMAX,XSUTM,YSUTM,XS,YS,IS,JXS,JYS,NS,NRAMS,KUNITG,JUNIT   00004930
                       & ,QBSUM,PQBSUM,QBTOT,PQBTOT,Z0MEAN)                            00004940
                  C                                                                    00004950
                  C.... THIS ROUTINE READ IN GEOGRAPHICAL AND ANNUAL EMISSION DATA.     00004960
                  C      IT ALSO: 1) FIX UTM COORDINATES FOR ALL NUMERICAL GRIDS.       00004970
                  C               2) CONVERT LOCATION OF RAMS STATION TO NUMERICAL GRID. 00004980
                  C               3) CONVERT LOCATION OF POINT SOURCE TO NUMERICAL GRID. 00004990
                  C                                                                    00005000
  ISN 0003              DIMENSION                                                      00005010
                       *  QB(IM,JM),ZS(IM,JM),Z0(IM,JM)                                00005020
                       *  ,PQB(LM),XPUTM(LM),YPUTM(LM),XP(LM),YP(LM),ZP(LM),ZR(LM),NP(LM) 00005030
                       *  ,IS(NS),XSUTM(NS),YSUTM(NS),JXS(NS),JYS(NS),XS(NS),YS(NS)    00005040
                       *  ,IUTM(IM),JUTM(JM),DX(IM),DY(JM)                             00005050
  ISN 0004              DIMENSION FMTDS(10)                                            00005060
                  C                                                                    00005070
  ISN 0005              DATA DXA/1000.0/,DYA/1000.0/                                   00005080
                  C                                                                    00005090
  ISN 0006         8000 FORMAT (4I5)                                                   00005100
  ISN 0007         8010 FORMAT (10A4)                                                  00005110
  ISN 0008         8050 FORMAT (F10.4)                                                 00005120
  ISN 0009         8090 FORMAT (F10.1)                                                 00005130
                  C                                                                    00005140
                  C.... READ ORGIN OF UMT COORDINATE AND FIX FOR ALL GRIDS.            00005150
  ISN 0010              READ (KUNITG,8000) IXBEG,IYBEG,IBEG,JBEG                       00005160
                  C                                                                    00005170
  ISN 0011              CALL      XYUTMS                                               00005180
                      & (IUTM,JUTM,IXBEG,IYBEG,IBEG,JBEG,DX,DY,DXA,DYA,IM,JM)          00005190
                  C                                                                    00005200
                  C                                                                    00005210
                  C.... READ IN UTM COORDINATES OF RAMS STATIONS.                      00005220
  ISN 0012              READ (KUNITG,8000) NRAMS                                       00005230
  ISN 0013              READ (KUNITG,8010) FMTDS                                       00005240
  ISN 0014              READ (KUNITG,FMTDS) (IS(L),XSUTM(L),YSUTM(L),L=1,NRAMS)        00005250
                  C                                                                    00005260
                  C.... CONVERT STATION FROM UTM UNIT (XSUTM,YSUTM) TO GRID UNIT(XS,YS). 00005270
                  C                                                                    00005280
  ISN 0015              CALL      XYUTMI      (XSUTM,YSUTM,NS,XS,YS,NS,1)              00005290
                  C                                                                    00005300
  ISN 0016              DO 100 L=1,NRAMS                                               00005310
  ISN 0017              JXSI=XS(L)+1.0001                                              00005320
  ISN 0018              JYSI=YS(L)+1.0001                                              00005330
  ISN 0019              IF (JXSI .LT. 1) JXSI=1                                        00005340
  ISN 0021              IF (JXSI .GT. IM) JXSI=IM                                      00005350
  ISN 0023              IF (JYSI .LT. 1) JYSI=1                                        00005360
  ISN 0025              IF (JYSI .GT. JM) JYSI=JM                                      00005370
  ISN 0027              JXS(L)=JXSI                                                    00005380
  ISN 0028              JYS(L)=JYSI                                                    00005390
  ISN 0029          100 CONTINUE                                                       00005400
                  C                                                                    00005410
                  C.... READ IN SURFACE ROUGHNESS                                      00005420
  ISN 0030              READ (KUNITG,8010) FMTDS                                       00005430
  ISN 0031              READ (KUNITG,FMTDS) Z0                                         00005440
  ISN 0032              IF (Z0MEAN.LE.0.0) GO TO 120                                   00005450
ISN 0034          DO 110 J=1,JM
ISN 0035          DO 110 I=1,IM
ISN 0036           ZO(I,J)=ZOMEAN
ISN 0037      110 CONTINUE
ISN 0038          DO 115 J=11,27
ISN 0039          DO 115 I=5,14
ISN 0040          ZO(I,J)= 2.0
ISN 0041      115 CONTINUE
ISN 0042      120 CONTINUE
            C
            C.... READ IN AREA SOURCE EMISSION HEIGHT
ISN 0043          READ (KUNITG,8010) FMTDS
ISN 0044          READ (KUNITG,FMTDS) ZS
            C
            C.... READ IN POINT SOURCES LOCATION AND STACK HEIGHT.
ISN 0045          READ (KUNITG,8000) LMAX
ISN 0046          READ (KUNITG,8010) FMTDS
ISN 0047          READ (KUNITG,FMTDS) (NP(L),XPUTM(L),YPUTM(L),ZP(L),L=1,LMAX)
            C
            C.... READ IN AREA SOURCE EMISSION RATES
ISN 0048          READ (KUNITG,8010) FMTDS
ISN 0049          READ (KUNITG,FMTDS) QB
ISN 0050          READ (KUNITG,8050) QBTOT
            C
            C.... OBTAIN AVERAGE EMISSION RATE FOR WINTER MONTHS
ISN 0051          DO 150 J=1,JM
ISN 0052          DO 150 I=1,IM
ISN 0053      150 QB(I,J)=QB(I,J)*4.0
ISN 0054          QBSUM=QBTOT*4.0
            C
            C.... READ IN POINT SOURCE EMISSION RATES.
ISN 0055          READ (KUNITG,8010) FMTDS
ISN 0056          READ (KUNITG,FMTDS) (PQB(L),L=1,LMAX)
ISN 0057          READ (KUNITG,8090) PQBTOT
            C
            C.... READ IN PLUME RISE DATA.
ISN 0058          READ (KUNITG,8010) FMTDS
ISN 0059          READ (KUNITG,FMTDS) (ZR(L),L=1,LMAX)
            C
            C.... CONVERT XP,YP FROM UTM COORDINATE TO NUMERICAL GRID
ISN 0060          PQBSUM=0.0
ISN 0061          DO 200 L=1,LMAX
ISN 0062          IF (NP(L) .EQ. 39) PQB(L)=0.0
ISN 0064          PQBSUM=PQBSUM+PQB(L)
ISN 0065      200 CONTINUE
            C
            C.... CONVERT POINT SOURCE FROM UTM UNIT(XPUTM,YPUTM) TO GRID UNIT(XP,YP
            C
ISN 0066          CALL       XYUTM1       (XPUTM,YPUTM,LM,XP,YP,LM,1)
            C
ISN 0067          RETURN
            C     DEBUG SUBCHK
ISN 0068          END

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      67 ,PROGRAM SIZE =     2934
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C
  ISN 0002               SUBROUTINE OUTAPE (CC,ICAL,IOBS,NSX,IM,JM,IDAYTP,IHRTP,LWARM)
                   C
                   C     THIS SUBROUTINE WRITES COMPUTED RESULTS ON TWO I/O UNITS
                   C      UNIT=KUNITP- PARM,CC,ICAL,IOBS.
                   C      UNIT=KUNITC- PARM,ICAL,IOBS.
                   C
  ISN 0003               DIMENSION CC(IM,JM),ICAL(NSX),IOBS(NSX)
                   C
  ISN 0004               COMMON    /AADATA/
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U*,PHIFHZ,HFZ
                   C
  ISN 0005           800 FORMAT (1X,4I2,F6.1,F6.0,F6.1,F6.2,F6.1,2F6.0
                        &        ,2F6.1,F9.0,4(/7X,13I5))
  ISN 0006           830 FORMAT ( '  TAPE,IMO,IDAY,IHR =  ',3I3)
  ISN 0007           831 FORMAT ('  *** ERR=291 ***')
  ISN 0008           832 FORMAT ('  *** END=292 ***')
                   C
  ISN 0009               IHRP=IHR
  ISN 0010               IDAYP=IDAY
  ISN 0011               IF (IHR.EQ.0) IDAYP=IDAY-1
  ISN 0013               IF (IHR.EQ.0) IHRP=24
  ISN 0015               IF (ITM.NE.0) GO TO 310
                   C
                   C.... INITIALIZE OUTPUT DATA SET. (ONLY WHEN ITM=0)
  ISN 0017               LWARM=1
  ISN 0018               IF ((IDAY.EQ.IDAYTP).AND.(IHR.EQ.(IHRTP-1))) LWARM=0
                   C
                   C.... IF COLD START, RETURN.....
                   C.... IF WARM START, GET DATA SET KUNITC AND KUNITP READY.
                   C
  ISN 0020               IF (LWARM.EQ.0) RETURN
  ISN 0022               IF (LWRITE(9) .EQ. 0) GO TO 200
  ISN 0024               REWIND KUNITC
  ISN 0025           100 READ (KUNITC,800,ERR=291,END=200) KYR,KMO,KDAY,KHR,PARM,ICAL,IOBS
  ISN 0026               IF ((KDAY.NE.IDAYP) .OR. (KHR.NE.IHRP)) GO TO 100
                   C.... THIS BACKSPACE IS TO PREVENT THE LOST OF POINTER IN BUFFER.
                   C     DO 110 L=1,5
                   C     BACKSPACE KUNITC
                   C 110 CONTINUE
                   C     WRITE (KUNITC,800) KYR,KMO,KDAY,KHR,PARM,ICAL,IOBS
  ISN 0028           200 CONTINUE
                   C
  ISN 0029               IF (LWRITE(10) .EQ. 0) GO TO 300
  ISN 0031               REWIND KUNITP
  ISN 0032           220 READ (KUNITP,ERR=291,END=292) KYR,KMO,KDAY,KHR,PARM,CC,ICAL,IOBS
  ISN 0033               WRITE (JUNIT,830) KMO,KDAY,KHR
  ISN 0034               IF ((KDAY.NE.IDAYP).OR.(KHR.NE.IHRP)) GO TO 220
                   C.... SAME REASON AS FOR BACKSPACE KUNITC
                   C     BACKSPACE KUNITP
                   C     WRITE(KUNITP,ERR=291,END=292)KYR,KMO,KDAY,KHR,PARM,CC,ICAL,IOBS
  ISN 0036           GO TO 300
  ISN 0037       291 WRITE (JUNIT,831)                                                     00006550
  ISN 0038           STOP 291                                                              00006560
  ISN 0039       292 WRITE (JUNIT,832)                                                     00006570
  ISN 0040           STOP 292                                                              00006580
  ISN 0041       300 CONTINUE                                                              00006590
               C                                                                           00006600
  ISN 0042           RETURN                                                                00006610
               C                                                                           00006620
               C.... WRITE STATMENTS.                                                      00006630
               C                                                                           00006640
  ISN 0043       310 CONTINUE                                                              00006650
               C                                                                           00006660
  ISN 0044           IF (LWRITE(9).EQ.0) GO TO 320                                         00006670
  ISN 0046           WRITE (KUNITC,800) IYR,IMO,IDAYP,IHRP,PARM,ICAL,IOBS                  00006680
  ISN 0047       320 CONTINUE                                                              00006690
  ISN 0048           IF (LWRITE(10).EQ.0) GO TO 340                                        00006700
  ISN 0050           WRITE (KUNITP) IYR,IMO,IDAYP,IHRP,PARM,CC,ICAL,IOBS                   00006710
  ISN 0051       340 CONTINUE                                                              00006720
               C                                                                           00006730
               C *** INITIALIZE CC ARRAY ***                                               00006740
  ISN 0052           DO 400 J=1,JM                                                         00006750
  ISN 0053           DO 400 I=1,IM                                                         00006760
  ISN 0054       400 CC(I,J)=0.                                                            00006770
               C                                                                           00006780
  ISN 0055           RETURN                                                                00006790
               C     DEBUG SUBCHK                                                          00006800
  ISN 0056           END                                                                   00006810
                                                                                           00006820
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       55 ,PROGRAM SIZE =      1806

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******
                                                                      117K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                              OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
               C                                                                      00006830
  ISN 0002           SUBROUTINE POSITV (   A, IM, JM, KM, IMJM, IJKM)                 00006840
               C                                                                      00006850
               C.... THIS SUBROUTINE  SET A(IJK)=0., IF IT HAS A NEGATIVE VALUE.      00006860
               C                                                                      00006870
  ISN 0003           DIMENSION A(IJKM)                                                00006880
               C                                                                      00006890
  ISN 0004           KK=-IMJM                                                         00006900
  ISN 0005           DO 10 K=1,KM                                                     00006910
  ISN 0006           KK=KK+IMJM                                                       00006920
  ISN 0007           JJ=-IM                                                           00006930
  ISN 0008           DO 10 J=1,JM                                                     00006940
  ISN 0009           JJ=JJ+IM                                                         00006950
  ISN 0010           DO 10 I=1,IM                                                     00006960
  ISN 0011           IJK=I+JJ+KK                                                      00006970
  ISN 0012           IF ( A(IJK) .LT. 0.0) A(IJK)=0.0                                 00006980
  ISN 0014        10 CONTINUE                                                         00006990
               C                                                                      00007000
  ISN 0015           RETURN                                                           00007010
               C     DEBUG SUBCHK                                                     00007020
  ISN 0016           END                                                              00007030

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       15 ,PROGRAM SIZE =      408

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                125K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                      OS/360  FORTRAN H

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                            SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                     00007040
  ISN 0002              SUBROUTINE PRINTS (CP1,CC,C1,COLD,IOBS,ICAL,KOBS,KCAL,ITOBS     00007050
                       *  ,U,V,W,U1,V1,UU,VV,AKZ,UZF,VZF,WZF,AKF,DX,DY                  00007060
                       *  ,IUTM,JUTM,XSUTM,YSUTM,XPUTM,YPUTM,ZO,ZS,QB,PQB               00007070
                       *  ,XP,YP,ZP,ZR,NP,IN,JN,KN,LM                                   00007080
                       *  ,IS,XS,YS,JXS,JYS,Z,IM,JM,KM,NS,NSX)                          00007090
                  C                                                                     00007100
                  C.... THIS SUBROUTINE PRINTS INPUT AND OUTPUT DATA OF THE MODEL.      00007110
                  C       ENTRY PRINTA -- HOURLY SOURCE EMISSION RATES.                 00007120
                  C       ENTRY PRINTB -- HOURLY METEOROLOGICAL PARAMETERS.             00007130
                  C       ENTRY PRINTC -- HOURLY CONCENTRATION VALUES.                  00007140
                  C                                                                     00007150
                  C.... PRINT OPTION IS CONTROL BY LWRITE(N). (SEE TABLE IN MAIN PROGRAM) 00007160
                  C                                                                     00007170
  ISN 0003              DIMENSION                                                       00007180
                       *        CP1(IM,JM,KM),CC(IM,JM),C1(IM,JM),COLD(IM,JM)           00007190
                       *       ,IOBS(NSX),ICAL(NSX),KCAL(NSX),KOBS(NSX),ITOBS(NSX)      00007200
                       *       ,U(IM,JM,KN),V(IM,JM,KN),W(IM,JM,KN),AKZ(IM,JM)          00007210
                       *       ,U1(IM,JM),V1(IM,JM),UU(IN,JN),VV(IN,JN)                 00007220
                       *       ,UZF(KM),VZF(KM),WZF(KM),AKF(KM),Z(KM),DX(IM),DY(JM)     00007230
                       *       ,XS(NS),YS(NS),IS(NS),JXS(NS),JYS(NS),XSUTM(NS),YSUTM(NS) 00007240
                       *       ,QB(IM,JM),PQB(LM),ZS(IM,JM),ZO(IM,JM),IUTM(IM),JUTM(JM) 00007250
                       *       ,XP(LM),YP(LM),ZP(LM),ZR(LM),NP(LM),XPUTM(LM),YPUTM(LM)  00007260
                  C                                                                     00007270
  ISN 0004              COMMON    /AADATA/                                              00007280
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW         00007290
                       *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC    00007300
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                  00007310
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00007320
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN            00007330
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UC,PHIFHZ,HFZ     00007340
                  C                                                                     00007350
  ISN 0005              REAL*4 TITLE1(10)/2*'    ',' FIE','LD  ','UNIT',' IN '          00007360
                       &                 ,2*'    ','', RA','TIO='/                      00007370
                       &      ,TITLE2(10)/2*'    ',' FIE','LD F','OR L','AYER'          00007380
                       &                 ,' K= ','    ','', RA','TIO='/                 00007390
                       &      ,LAYER(14)/'  1 ','  2 ','  3 ','  4 ','  5 ','  6 ','  7 ' 00007400
                       &                ,'  8 ','  9 ',' 10 ',' 11 ',' 12 ',' 13 ',' 14 '/00007410
                       &      ,TITLQB/'* QB'/,  TITLZO/'* ZO'/,  TITLZS/'* ZS'/         00007420
                       &      ,TITLKZ/'* KZ'/,  TITLC1/'* C1'/,  TITLCC/'* CC'/         00007430
                       &      ,TITLL1/'1 **'/,  TITLL2/'0 **'/,  TITLL3/'  **'/         00007440
                       &      ,TUNIT1/'G/S '/,  TUNIT2/' M. '/                          00007450
                  C                                                                     00007460
  ISN 0006         8110 FORMAT ('1 ***** LOCATION OF ',I2,' RAMS STATIONS *****'//      00007470
                       & '   IS',4X,'XSUTM',5X,'YSUTM',6X,'XS',6X,'YS',3X,'JXS',3X,'JYS') 00007480
  ISN 0007         8120 FORMAT (I5,2F10.2,2F8.2,2I6)                                    00007490
  ISN 0008         8140 FORMAT (//5X,'.... TOTAL EMISSION : READ IN=',F10.1             00007500
                       &      ,',   MODEL USED=',F10.1,',  IN G/SEC')                   00007510
  ISN 0009         8150 FORMAT ('1 *** POINT SOURCE DATA ***'/                          00007520
                       &       5X,'..... TOTAL NUMBER =',I5,//'   N '                   00007530
                       &       ,'   ID',5X,'XPUTM',5X,'YPUTM',8X,'ZP',8X,'QP'           00007540
                       &       ,8X,'ZR',6X,'XP',6X,'YP')                                00007550
  ISN 0010         8160 FORMAT (2I5,3F10.1,F10.2,F10.1,2F8.2)                           00007560
                  C                                                                     00007570
  ISN 0011              QBSUM=PARM(6)                                                   00007580
  ISN 0012              PQBSUM=PARM(7)                                                  00007590
```

```
                   C
                   C *** PRINT GEOGRAPHICAL AND ANNUAL EMISSION DATA ***
                   C
                   C.... INITIALIZE SUBROUTINE WRITES, WHICH HAS ENTRY WRITEX.
                   C
ISN 0013                 CALL       WRITES
                        &      (QB,IM,JM,IM,JM,1,1,IJTM,JUTM,IM,JUNIT,RATIO,TITLE1)
                   C
ISN 0014                 IF (LWRITE(1).EQ.0) RETURN
                   C
                   C.... RAMS STATIONS.
                   C
ISN 0016                 WRITE (JUNIT,8110) NS
ISN 0017                 WRITE (JUNIT,8120)
                        &  (IS(L),XSUTM(L),YSUTM(L),XS(L),YS(L),JXS(L),JYS(L),L=1,NS)
                   C
                   C.... SURFACE ROUGHNESS.
ISN 0018                 RATIO=100.
ISN 0019                 TITLE1(1)=TITLL1
ISN 0020                 TITLE1(2)=TITLZ0
ISN 0021                 TITLE1(7)=TUNIT2
                   C
ISN 0022                 CALL       WRITEX
                        &      (Z0,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE1)
                   C
                   C.... EMMISION HEIGHT OF AREA SOURCE.
                   C
ISN 0023                 RATIO=1.0
ISN 0024                 TITLE1(2)=TITLZS
                   C
ISN 0025                 CALL        WRITEX
                        &      (ZS,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE1)
                   C
                   C.... EMISSION RATE OF AREA SOURCE.
                   C
ISN 0026                 RATIO=1.0
ISN 0027                 TITLE1(2)=TITLQB
ISN 0028                 TITLE1(7)=TUNIT1
                   C
ISN 0029                 CALL       WRITEX
                        &      (QB,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE1)
                   C
ISN 0030                 WRITE (JUNIT,8140) QBTOT,QBSUM
                   C
                   C.... POINT SOURCE DATA
                   C
ISN 0031                 WRITE (JUNIT,8150) LM
ISN 0032                 WRITE (JUNIT,8160)
                        &(L,NP(L),XPUTM(L),YPUTM(L),ZP(L),PQB(L),ZR(L),XP(L),YP(L),L=1,LM)
ISN 0033                 WRITE (JUNIT,8140) PQBTOT,PQBSUM
                   C
ISN 0034                 RETURN
                   C
                   C     ------------------------------------------------------------
                   C
                   C *** PRINTS TIME VARYING SOURCE EMISSION RATES ***
                   C
ISN 0035                 ENTRY PRINTA
```

```
                   C
ISN 0036            8200 FORMAT (1X,'** TOTAL SOURCE QBTOT=',F10.1,' PQBTOT=',F10.1
                       &        ,' QBSUM=',F10.1,' PQBSUM=',F01.1)
ISN 0037            8240 FORMAT ( /1X,'** POINT SOURCE **'/,(5(1X,I3,2F9.1)))
                   C
ISN 0038                 IF (LWRITE(2).LE.0) GO TO 200
ISN 0040                 QBSUM=PARM(6)
ISN 0041                 PQBSUM=PARM(7)
ISN 0042                 WRITE (JUNIT,8200) QBTOT,PQBTOT,QBSUM,PQBSUM
ISN 0043                 IF (LWRITE(2).LT.2) GO TO 200
ISN 0045                 TITLE1(1)=TITLL2
ISN 0046                 TITLE1(2)=TITLQB
ISN 0047                 TITLE1(7)=TUNIT1
                   C
ISN 0048                 IF ((LWRITE(2).EQ.2).OR.(LWRITE(2).EQ.4))     CALL     WRITEX
                        & (QB,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE1)
                   C
ISN 0050                 IF (LWRITE(2).GE.3) WRITE (JUNIT,8240) (L,PQB(L),ZR(L),L=1,LM)
ISN 0052              200 CONTINUE
                   C
ISN 0053                 RETURN
                   C
                   C     ---------------------------------------------------
                   C
                   C *** PRINTS METEOROLOGICAL PARAMETERS AND MODEL DATA ***
                   C
ISN 0054                 ENTRY PRINTB (RH)
                   C
ISN 0055            8300 FORMAT (1X,'   ***** RAMS DATA *****'/'  IS ',25I5/
                       &       '  UU ',25F5.1/'  DD ',25F5.0/'  T1 ',25F5.0/
                       &       '  T2 ',25F5.0/'  CC ',25F5.0/'  RA ',25F5.0)
ISN 0056            8310 FORMAT (1X,'   ***** ANALYZED WIND UU(IN,JN) & VV(IN,JN) *****'/
                       &        ,5X,'J',9(' ----',I2,'---- '))
ISN 0057            8320 FORMAT (1X,I5,18F6.1)
ISN 0058            8400 FORMAT (1X,' ** U,V WIND COMPONENTS FOR LAYER K=',I2,' **'/
                       &        ,5X,'J',10(' ----',I2,'---- '))
ISN 0059            8410 FORMAT (1X,I5,20F6.1)
ISN 0060            8420 FORMAT (1X,' ** W WIND COMPONENT FOR LAYER K=',I2,' **'/
                       &        ,5X,'J',10(' ----',I2,'---- '))
ISN 0061            8430 FORMAT (1X,I5,10(1X,F10.4,1X))
ISN 0062            8450 FORMAT (/,' RH=',F6.2,'  GRID Z(K)= ',14F6.0)
ISN 0063            8460 FORMAT (15X,'UZF(K)= ',14F6.2)
ISN 0064            8470 FORMAT (15X,'VZF(K)= ',14F6.2)
ISN 0065            8480 FORMAT (15X,'WZF(K)= ',14F6.2)
ISN 0066            8500 FORMAT (15X,'AKF(K)= ',14F6.2)
ISN 0067            8510 FORMAT (11X,'KZ(J=JM/2)= ',15F6.1)
ISN 0068            8600 FORMAT (' DT=',F6.1,4X,'PARM(N)= ',10F10.2)
ISN 0069            8610 FORMAT (3X,'U0=',F8.3,'  PHZ=',F8.3;'  HFZ=',F8.3,'  RIB=',F8.3)
                   C
                   C.... RAMS DATA.
ISN 0070                 IF (LWRITE(3).GE.1)
                       &     WRITE (JUNIT,8300) IS,((RAMS(I,J),J=1,NS),I=1,6)
                   C
                   C.... ANALYZED WIND FIELD.
ISN 0072                 IF ((KWIND.NE.2).OR.(KWIND.NE.4)) GO TO 320
ISN 0074                 IF (LWRITE(3).NE.2) GO TO 320
ISN 0076                 WRITE (JUNIT,8310) (I,I=1,IN)
ISN 0077                 DO 310 JJ=1,JN
ISN 0078          J=JM+1-JJ
ISN 0079          WRITE (JUNIT,8320) J,(UU(I,J),VV(I,J),I=1,IN)
ISN 0080      310 CONTINUE
ISN 0081      320 CONTINUE
            C
            C.... WIND FIELD AT NUMERICAL GRIDS.
ISN 0082          IF (LWRITE(4).EQ.0) GO TO 500
ISN 0084          IF (LWRITE(4).LT.2) GO TO 440
ISN 0086          K=1
ISN 0087          WRITE (JUNIT,8400) K,(I,I=2,IM,3)
ISN 0088          DO 410 JJ=1,JM,4
ISN 0089          J= JM+1-JJ
ISN 0090      410 WRITE (JUNIT,8410) J,(U(I,J,1),V(I,J,1),I=2,IM,3)
ISN 0091          IF (LWW.NE.1) GO TO 420
ISN 0093          WRITE (JUNIT,8420) K,(I,I=2,IM,3)
ISN 0094          DO 415 JJ=1,JM,4
ISN 0095          J=JM+1-JJ
ISN 0096      415 WRITE (JUNIT,8430) J,(W(I,J,1),I=2,IM,3)
ISN 0097      420 CONTINUE
ISN 0098          IF (LWRITE(4).NE.3) GO TO 440
ISN 0100          DO 430 K=2,KN
ISN 0101          WRITE (JUNIT,8400) K,(I,I=2,IM,3)
ISN 0102          DO 430 JJ=1,JM,4
ISN 0103           J=JM+1-JJ
ISN 0104          WRITE (JUNIT,8410) J,(U(I,J,K),V(I,J,K),I=2,IM,3)
ISN 0105      430 CONTINUE
ISN 0106          IF (LWW.NE.1) GO TO 440
ISN 0108          DO 435 K=2,KN
ISN 0109          WRITE (JUNIT,8420)  K,(I,I=2,IM,3)
ISN 0110          DO 435 JJ=1,JM,4
ISN 0111          J=JM+1-JJ
ISN 0112          WRITE (JUNIT,8430) J,(W(I,J,K),I=2,IM,3)
ISN 0113      435 CONTINUE
ISN 0114      440 CONTINUE
            C
            C.... VERTICAL GRIDS AND WIND PROFILE
ISN 0115          WRITE (JUNIT,8450) RH,(Z(K),K=1,KM)
ISN 0116          WRITE (JUNIT,8460) (UZF(K),K=1,KM)
ISN 0117          WRITE (JUNIT,8470) (VZF(K),K=1,KM)
ISN 0118          IF (LWW.EQ.1) WRITE (JUNIT,8480) (WZF(K),K=1,KM)
ISN 0120      500 CONTINUE
            C
            C.... EDDY DIFFUSIVITY.
ISN 0121          IF (LWRITE(5).GE.1) WRITE (JUNIT,8500) (AKF(K),K=1,KM)
ISN 0123          JJ=JM/2
ISN 0124          IF (LWRITE(5).EQ.2)
                &   WRITE (JUNIT,8510) (AKZ(I,JJ),I=1,IM,2)
ISN 0126          RATIO=10.0
ISN 0127          TITLE2(1)=TITLL2
ISN 0128          TITLE2(2)=TITLKZ
ISN 0129          TITLE2(8)=LAYER(1)
            C
ISN 0130          IF (LWRITE(5).EQ.3)
                &   CALL WRITEX (AKZ,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE2)
            C
            C.... METEOROLOGICAL PARAMETERS.
ISN 0132          IF (LWRITE(6).EQ.0) GO TO 600
ISN 0134          WRITE (JUNIT,8600) DT,PARM
ISN 0135          IF (LWRITE(6).EQ.2) WRITE (JUNIT,8610) UO,PHIFHZ,HFZ,PIB                00009340
ISN 0137      600 CONTINUE                                                                00009350
            C                                                                             00009360
ISN 0138          RETURN                                                                  00009370
            C                                                                             00009380
            C     ----------------------------------------------------------              00009390
            C                                                                             00009400
            C *** PRINT CONCENTRATION FIELD ***                                           00009410
            C                                                                             00009420
ISN 0139          ENTRY PRINTC (IMC,JMC  )                                                00009430
            C                                                                             00009440
            C.... THIS ROUTINE PRINTS (ACCORDING TO CONTROL FLAG) :                       00009450
            C      1) INSTANTANEOUS CP1 AT STATIONS FOR EACH TIME STEP;                   00009460
            C      2) INSTANTANEOUS CP1 FIELD AT EACH TIME INTERVAL 'LPRINT';             00009470
            C      3) AVERAGE CONC. CC FIELD AT EACH TIME INTERVAL 'LPRINT';              00009480
            C      4) AVERAGE CONC. CC AT STATIONS (IOBS,ICAL); AND                       00009490
            C      5) 24 HOURS AVERAGE CONC. AT STATIONS (KOBS,KCAL).                     00009500
            C     NS = NO. OF RAMS STATION.  NSX = NS+1 .                                 00009510
            C     NSX IS INDEX FOR SPATIAL AVERAGE. F(NSX)= AVERAGE OF F(L),L=1,NS.       00009520
            C                                                                             00009530
ISN 0140          DATA ITPR/0/                                                            00009540
            C                                                                             00009550
ISN 0141     8700 FORMAT (/3X,'TIME',3X,' SEC NTS',4X,'DT',2X,25I4)                       00009560
ISN 0142     8710 FORMAT (1X,I2,2('/',I2),I5,I4,F6.0,2X,25I4)                             00009570
ISN 0143     8800 FORMAT (//,' ** 2HR STATION SO2 ** MO,DAY,HR=',3(I2,'/'),',  NTS='00009580
                &       ,I4,',   ... SPATIAL AVERAGE... CAL=',I5,' OBS=',I5)             00009590
ISN 0144     8810 FORMAT (//,' ** 24HR STATION SO2 ** MO,DAY,HR=',3(I2,'/')               00009600
                &       ,',   ... SPATIAL AVERAGE... CAL=',I5,' OBS=',I5)                00009610
ISN 0145     8820 FORMAT ('  IS ',25I5/'  XS ',25F5.1/'. YS ',25F5.1/                     00009620
                &       ,' CAL ',25I5,/' OBS ',25I5)                                      00009630
            C                                                                             00009640
            C *** PRINT INSTANTANEOUS CONCENTRATION AT MONITORING STATIONS ***            00009650
            C.... THESE VALUES ARE FROM NEAREST SOUTHWEST GRID TO STATIONS.               00009660
ISN 0146          RATIO=1.0                                                               00009670
ISN 0147          IF ((LWRITE(7).NE.2).AND.(LWRITE(7).NE.4)) GO TO 730                    00009680
ISN 0149          IF (ITPR.GT.0) GO TO 710                                                00009690
ISN 0151          ITPR=1                                                                  00009700
ISN 0152          WRITE (JUNIT,8700) (IS(L),L=1,NS)                                       00009710
ISN 0153      710 CONTINUE                                                                00009720
ISN 0154          DO 720 L=1,NS                                                           00009730
ISN 0155          I=JXS(L)                                                                00009740
ISN 0156          J=JYS(L)                                                                00009750
ISN 0157      720 ICAL(L)=CP1(I,J,1)                                                      00009760
ISN 0158          WRITE (JUNIT,8710) IMO,IDAY,IHR,ITSEC,ITSTEP,DT,(ICAL(L),L=1,NS)        00009770
ISN 0159      730 CONTINUE                                                                00009780
            C                                                                             00009790
ISN 0160          IF (LCRUN .EQ. 0) RETURN                                                00009800
            C                                                                             00009810
            C *** PRINT INSTANTANEOUS CONC. CP1 FIELD EVERY LPRINT INTERVAL ***           00009820
            C                                                                             00009830
            C.... IF NOT ON THE HOUR, RETURN TO TIME STEP LOOP OF MAIN PROGRAM.           00009840
ISN 0162          IF (ITM .NE. (ITM/LPRINT*LPRINT)) RETURN                                00009850
            C                                                                             00009860
ISN 0164          ITPR=0                                                                  00009870
ISN 0165          IF (LWRITE(7).LE.0) GO TO 770                                           00009880
ISN 0167          IF (LWRITE(7).LE.2) GO TO 760                                           00009890
ISN 0169          KB=1                                                                    00009900
ISN 0170          KA=1                                                                    00009910
ISN 0171          IF (IHR.EQ.0) KB=KM                                                 00009920
            C                                                                         00009930
            C.... PRINT HORIZONTAL FIELD OF CP1.                                      00009940
ISN 0173          TITLE2(1)=TITLL2                                                    00009950
ISN 0174          TITLE2(2)=TITLC1                                                    00009960
ISN 0175          DO 750 K=KA,KB                                                      00009970
ISN 0176          TITLE2(8)=LAYER(K)                                                  00009980
ISN 0177          DO 740 J=1,JM                                                       00009990
ISN 0178          DO 740 I=1,IM                                                       00010000
ISN 0179          COLD(I,J)=CP1(I,J,K)                                                00010010
ISN 0180      740 CONTINUE                                                            00010020
            C                                                                         00010030
ISN 0181          CALL     WRITEX     (COLD,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE2)        00010040
            C                                                                         00010050
ISN 0182      750 CONTINUE                                                            00010060
            C                                                                         00010070
            C.... PRINT VERTICAL CROSS SECTION OF CP1 AT I=IMC, J=JMC.                00010080
ISN 0183      760 CONTINUE                                                            00010090
            C                                                                         00010100
ISN 0184          CALL     WRITEZ     (CP1,Z,RATIO,IM,JM,KM,IMC,JMC,TITLC1)           00010110
            C                                                                         00010120
ISN 0185      770 CONTINUE                                                            00010130
            C                                                                         00010140
            C *** PRINT CC FIELD EVERY LPRINT INTERVAL ***                            00010150
            C.... CC IS AVERAGE SURFACE CONCENTRATION FIELD OF LPRINT INTERVAL.       00010160
ISN 0186          TITLE2(1)=TITLL1                                                    00010170
ISN 0187          TITLE2(2)=TITLCC                                                    00010180
ISN 0188          TITLE2(8)=LAYER(1)                                                  00010190
            C                                                                         00010200
ISN 0189          IF (LWRITE(8).GE.2)     CALL     WRITEX                             00010210
                 & (CC,IM,JM,IM,JM,IM,JUNIT,RATIO,TITLE2)                             00010220
            C                                                                         00010230
            C *** OBTAIN VALUES OF CC AT RAMS STATION ***                             00010240
            C                                                                         00010250
ISN 0191          CALL     STNCON                                                     00010260
                 & (CC,IOBS,ICAL,KOBS,KCAL,ITOBS,NS,NSX,IM,JM,XS,YS,JXS,JYS)          00010270
            C                                                                         00010280
            C *** PRINT VALUES OF CC AT RAMS STATION ***                              00010290
ISN 0192          IF (LWRITE(8).LT. 1) GO TO 780                                      00010300
ISN 0194          WRITE (JUNIT,8800)  IMO,IDAY,IHR,ITSTEP,ICAL(NSX),IOBS(NSX)         00010310
ISN 0195          WRITE (JUNIT,8820) IS,XS,YS,(ICAL(L),L=1,NS),(IOBS(L),L=1,NS)       00010320
ISN 0196      780 CONTINUE                                                            00010330
            C                                                                         00010340
            C *** PRINT 24 HR AVERAGE CONCENTRATION AT RAMS STATIONS ***               00010350
ISN 0197          IF (IHR .NE. 0 ) GO TO 910                                          00010360
ISN 0199          WRITE (JUNIT,8810) IMO,IDAY,IHR,KCAL(NSX),KOBS(NSX)                 00010370
ISN 0200          WRITE (JUNIT,8820) IS,XS,YS,(KCAL(L),L=1,NS),(KOBS(L),L=1,NS)       00010380
            C                                                                         00010390
            C *** INITIALIZE ARRAY OF 24 HOUR AVERAGE ***                             00010400
ISN 0201          DO 900 L=1,NS                                                       00010410
ISN 0202          KOBS(L)=0                                                           00010420
ISN 0203          KCAL(L)=0                                                           00010430
ISN 0204      900 ITOBS(L)=0                                                          00010440
            C                                                                         00010450
ISN 0205      910 CONTINUE                                                            00010460
ISN 0206          RETURN                                                              00010470
            C     DEBUG SUBCHK                                                        00010480
ISN 0207          END                                                                 00010490
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                                        FORTRAN H ERROR MESSAGES
                   ERROR NO   LEVEL         ERROR MESSAGE

    NAME  TITLL3   IEK307I       4          THE DATA STATEMENT CONTAINS A VARIABLE THAT IS NOT REFERENCED.

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =     206 ,PROGRAM SIZE =     9356

*STATISTICS*    1 DIAGNOSTICS GENERATED, HIGHEST SEVERITY CODE IS  4

****** END OF COMPILATION ******                                            53K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                         00010500
   ISN 0002             SUBROUTINE SHIFTN ( A, B, IM, JM, KM, IN, JN, KN)                   00010510
                  C                                                                         00010520
                  C.... SHIFT A TO B                                                        00010530
                  C                                                                         00010540
   ISN 0003             DIMENSION A(IM,JM,KM),  B(IN,JN,KN)                                 00010550
                  C                                                                         00010560
   ISN 0004             IMM=IN                                                              00010570
   ISN 0005             JMM=JN                                                              00010580
   ISN 0006             KMM=KN                                                              00010590
   ISN 0007             IF ( KM .LE. KN) KMM=KM                                             00010600
   ISN 0009             IF( IM .LE. IN ) IMM=IM                                             00010610
   ISN 0011             IF( JM .LE. JN ) JMM=JM                                             00010620
   ISN 0013             DO 100 K=1,KMM                                                      00010630
   ISN 0014             DO 100 J=1,JMM                                                      00010640
   ISN 0015             DO 100 I=1,IMM                                                      00010650
   ISN 0016             B (I,J,K)= A( I,J,K)                                                00010660
   ISN 0017         100 CONTINUE                                                            00010670
                  C                                                                         00010680
   ISN 0018             RETURN                                                              00010690
                  C     DEBUG SUBCHK                                                        00010700
   ISN 0019             END                                                                 00010710
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      18 ,PROGRAM SIZE =      810

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                        125K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                      00010720
  ISN 0002              SUBROUTINE      SOURCE                                            00010730
                       * (CP1, C,QA,QB,ZS,PQA,PQB,XPUTM,YPUTM,XP,YP,ZP,ZR,ZPR,U,V,UZF,VZF 00010740
                       *  ,AKF,AKH,AKZ,DX,DY,DZ,Z,EK,FK,IM,JM,KM,KN,IMJM,LM)              00010750
                  C                                                                      00010760
                  C     THIS SUBROUTINE ADDS NEW SOURCE EMISSION INTO THE SYSTEM.         00010770
                  C                                                                      00010780
  ISN 0003              DIMENSION                                                         00010790
                       *        PQA(LM),PQB(LM),QA(IM,JM),QB(IM,JM)                       00010800
                       *        ,XPUTM(LM),YPUTM(LM),XP(LM),YP(LM),ZP(LM),ZR(LM),ZPR(LM)  00010810
                       *        ,CP1(IM,JM,KM), C(IM,JM,KM), ZS(IM,JM)                    00010820
                       *        ,U(IM,JM,KN), V(IM,JM,KN), UZF(KM), VZF(KM)               00010830
                       *        ,DX(IM),DY(JM),DZ(KM), Z(KM),EK(LM),FK(LM)                00010840
                       *        ,AKF(KM),AKH(KM),AKZ(IM,JM)                               00010850
                  C                                                                      00010860
  ISN 0004              COMMON    /AADATA/                                                00010870
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW           00010880
                       *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC      00010890
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                    00010900
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00010910
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN             00010920
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ      00010930
                  C                                                                      00010940
  ISN 0005              DATA QMUGM/1000000./,CT1/0.027144/                                00010950
                  C                                                                      00010960
                  C     ---------------- AREA SOURCE ----------------                    00010970
                  C                                                                      00010980
  ISN 0006              IF (LSOUS(1) .EQ. 0) GO TO 200                                    00010990
                  C                                                                      00011000
                  C *** CONVERT ZS FROM (M) TO GRID UNIT ***                              00011010
                  C                                                                      00011020
  ISN 0008              IF (ITM.EQ.0)     CALL     ZZGRID     (ZS,ZS,Z,IMJM,IMJM,KM)     00011030
                  C                                                                      00011040
                  C *** ADD AREA SOURCE INTO GRID CELL ***                                00011050
  ISN 0010              DO 100 J=1,JM                                                     00011060
  ISN 0011              DO 100 I=1,IM                                                     00011070
  ISN 0012              ZSIJ=ZS(I,J)+1.001                                                00011080
  ISN 0013              KZS=ZSIJ                                                          00011090
  ISN 0014              IF (KZS .GE. KM) GO TO 100                                        00011100
  ISN 0016              DZSK=ZSIJ-KZS                                                     00011110
  ISN 0017              DZK=0.5*DZ(KZS)                                                   00011120
  ISN 0018              IF (KZS.GE. 2) DZK=0.5*(DZ(KZS)+DZ(KZS-1))                        00011130
  ISN 0020              DZK1=0.5*(DZ(KZS)+DZ(KZS+1))                                      00011140
  ISN 0021              DTQIJ=DT*QB(I,J)                                                  00011150
  ISN 0022              CP1(I,J,KZS)= CP1(I,J,KZS)+DTQIJ*(1.-DZSK)/DZK                    00011160
  ISN 0023              CP1(I,J,KZS+1)=CP1(I,J,KZS+1)+DTQIJ*DZSK/DZK1                     00011170
  ISN 0024          100 CONTINUE                                                          00011180
  ISN 0025          200 CONTINUE                                                          00011190
                  C                                                                      00011200
                  C     ------------------ POINT SOURCE --------------------             00011210
                  C                                                                      00011220
                  C.... POINT SOURCE IS ADDED AT EFFECTIVE HEIGHT ZPR=ZP+ZR AND           00011230
                  C        EFFECTIVE DOWNWIND LOCATION (X=X+U*DT,Y=Y+V*DT)                00011240
                  C                                                                      00011250
  ISN 0026              IF (LSOUS(2) .EQ. 0) RETURN                                       00011260
                  C                                                                      00011270
```

```
      LTMIN=LPRINT
      IF (ITM .NE.(ITM/LTMIN*LTMIN)) GO TO 410
C
C.... CALCULATE POINT SOURCE LOCATION IN GRID UNIT (XP,YP).
C
       CALL      XYUTM1      (XPUTM,YPUTM,LM,XP,YP,LM,1)
C
C.... CALCULATE HEIGHT (ZP) IN GRID UNIT & STORE IN ZPR TEMPORARILY.
C
      CALL      ZZGRID     (ZP,ZPR,Z,LM,LM,KM)
C
C *** COMPUTE EFFECTIVE HEIGHT & DOWNWIND LOCATION
C
      DO 400 L=1,LM
      IXP=XP(L)+1.00001
      IYP=YP(L)+1.00001
      IZP=ZPR(L)+1.00001
      IF (IZP .GE.KM) IZP=KM
      KK=IZP
      IF(KK .GT. KN) KK=KN
      UL=U(IXP,IYP,KK)*UZF(IZP)
      VL=V(IXP,IYP,KK)*VZF(IZP)
      UIJK=SQRT(UL*UL+VL*VL)
      ZRL=ZR(L)
      IF ( ZR(L) .GT. 9000.) ZRL=PQB(L)*ZRPQ
      ZRR=ZRISE*ZRL
      ZPRL=ZP(L)+ZRR/(UIJK+EXP(-UIJK))**0.75
      ZPR(L)=ZPRL
C.... TRANSFER TO NEW LOCATION DOWNWIND (EK,FK).
      TADVEC=DT
      IF (LPQ .GE. 3) GO TO 320
C ... CT1=1./(16.*ALOG(10.))
      T1=CT1*DX(IXP)*DY(IYP)/(AKH(IZP)*AKF(IZP)*AKZ(IXP,IYP))
      AKFMEN=0.0
      DO 300 KZ=1,IZP
  300 AKFMEN=AKFMEN+AKF(KZ)
      AKFMEN=AKFMEN/IZP
      T2=0.25*ZPRL*ZPRL/(AKFMEN*AKZ(IXP,IYP))
C     TADVEC=MINIMUM(T1,T2)
      TADVEC=T1
      IF (TADVEC.GT.T2) TADVEC=T2
  320 CONTINUE
      EK(L)=XPUTM(L)+0.001*TADVEC*UL
      FK(L)=YPUTM(L)+0.001*TADVEC*VL
  400 CONTINUE
C
C.... CONVERT TEMPORARY LOCATION (EK,FK) TO GRID UNIT (XP,YP).
C
      CALL       XYUTM1      (EK,FK,LM,XP,YP,LM,1)
C
C.... CONVERT ZPR TO GRID UNIT.
C
      CALL      ZZGRID      (ZPR,ZPR,Z,LM,LM,KM)
  410 CONTINUE
C
C.... NOW (XP,YP,ZPR) ARE IN GRID UNIT....
C *** CONVERT EMISSION RATE TO DENSITY ACCORDING TO DT & GRID VOLUME ***
C
```

```
ISN 0070            DO 600 L=1,LM                                                 00011860
ISN 0071            IF (ZP(L) .GE. Z(KM)) GO TO 600                               00011870
ISN 0073            IXP=XP(L)+1.001                                               00011880
ISN 0074            IYP=YP(L)+1.001                                               00011890
              C                                                                   00011900
              C.... DISCARD POINTS OUTSIDE COMPUTATIONAL REGION.                  00011910
ISN 0075            IF ((IXP.LT. 1).OR.(IXP.GT.IM)) GO TO 600                     00011920
ISN 0077            IF ((IYP.LT. 1).OR.(IYP.GT.JM)) GO TO 600                     00011930
ISN 0079            ZPRL=ZPR(L)+1.001                                             00011940
ISN 0080            IZP=ZPRL                                                      00011950
ISN 0081            DZP=ZPRL-IZP                                                  00011960
ISN 0082            IZP1=IZP+1                                                    00011970
ISN 0083            IF (IZP .LT. KM) GO TO 510                                    00011980
ISN 0085            IZP=KM                                                        00011990
ISN 0086            IZP1=KM                                                       00012000
ISN 0087            DZP=0.0                                                       00012010
ISN 0088        510 CONTINUE                                                      00012020
ISN 0089            DZK=0.5*DZ(IZP)                                               00012030
ISN 0090            IF (IZP.GT.1) DZK=0.5*(DZ(IZP)+DZ(IZP-1))                     00012040
ISN 0092            DZK1=0.5*(DZ(IZP)+DZ(IZP1))                                   00012050
ISN 0093            DTPQ=DT*PQB(L)*QMUGM/(DX(IXP)*DY(IYP))                        00012060
              C                                                                   00012070
              C *** ADD POINT SOURCE INTO THE GRID CELL ***                        00012080
ISN 0094            IF ((LPQ .NE.1).AND.(LPQ.NE.3)) GO TO 500                     00012090
              C                                                                   00012100
              C.... ADD POINT SOURCE AT ONE GRID ONLY                             00012110
ISN 0096            CP1(IXP,IYP,IZP)=CP1(IXP,IYP,IZP)+DTPQ*(1.-DZP)/DZK           00012120
ISN 0097            CP1(IXP,IYP,IZP1)=CP1(IXP,IYP,IZP1)+DTPQ*DZP/DZK1             00012130
ISN 0098            GO TO 600                                                     00012140
              C                                                                   00012150
              C.... DISTRIBUTE SOURCE AT FOUR NEIGHBORING GRIDS                   00012160
ISN 0099        500 CONTINUE                                                      00012170
ISN 0100            IF ((LPQ.NE.2).AND.(LPQ.NE.4)) GO TO 600                      00012180
ISN 0102            A=XP(L)+0.5-IXP                                               00012190
ISN 0103            B=YP(L)+0.5-IYP                                               00012200
ISN 0104            DO 550 K=IZP,IZP1                                             00012210
ISN 0105            DTQ=DTPQ*(1.0-DZP)                                            00012220
ISN 0106            IF (K .EQ.IZP1) DTQ=DTPQ*DZP                                  00012230
ISN 0108            CP1(IXP,IYP,K)=CP1(IXP,IYP,K)+(1.0-A)*(1.0-B)*DTQ             00012240
ISN 0109            IF (IXP .GE. IM) GO TO 550                                    00012250
ISN 0111            CP1(IXP+1,IYP,K)= CP1(IXP+1,IYP,K)+ A*(1.0-B)*DTQ             00012260
ISN 0112            IF (IYP .GE. JM) GO TO 550                                    00012270
ISN 0114            CP1(IXP+1,IYP+1,K)= CP1(IXP+1,IYP+1,K)+ A*B*DTQ               00012280
ISN 0115            CP1(IXP  ,IYP+1,K)= CP1(IXP  ,IYP+1,K)+ (1.0-A)*B*DTQ         00012290
ISN 0116        550 CONTINUE                                                      00012300
ISN 0117        600 CONTINUE                                                      00012310
              C                                                                   00012320
ISN 0118            RETURN                                                        00012330
              C     DEBUG SUBCHK                                                  00012340
ISN 0119            END                                                           00012350

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =     118 ,PROGRAM SIZE =     4190

*STATISTICS*  NO  DIAGNOSTICS GENERATED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                    C                                                               00012360
   ISN 0002               SUBROUTINE SOUSIN (QB,ZS,ZO,PQB,XP,YP,ZP,ZR,IM,JM,LM)     00012370
                    C                                                               00012380
                    C ... IT READS IN SO2 SOURCE FROM AREA AND POINT SOURCES  ...   00012390
                    C                                                               00012400
   ISN 0003               DIMENSION                                                 00012410
                        *          3(IM,JM), ZS(IM,JM)   ,Z0(IM,JM)                 00012420
                        *        ,/R(LM), PQB(LM), XP(LM), YP(LM), ZP(LM)           00012430
                    C                                                               00012440
   ISN 0004               COMMON    /AADATA/                                        00012450
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW    00012460
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC 00012470
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                             00012480
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00012490
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN       00012500
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ 00012510
                    C                                                               00012520
   ISN 0005          870 FORMAT (' *END   IN READ SOUSIN* ')                        00012530
   ISN 0006          880 FORMAT (' *ERROR IN READ SOUSIN* ')                        00012540
                    C                                                               00012550
                    C *** SEARCH RIGHT RECORD IN UNIT=KUNITS ***                    00012560
   ISN 0007               IF (ITM .EQ. 0) REWIND KUNITS                             00012570
   ISN 0009          100 CONTINUE                                                   00012580
   ISN 0010               READ  (KUNITS,END=600,ERR  =700) KYR,KMO,KDAY,KHR         00012590
   ISN 0011               KHR2=KHR-2                                                00012600
   ISN 0012               IF ((KDAY .NE. IDAY) .OR.(KHR2 .NE. IHR)) GO TO 100       00012610
   ISN 0014               BACKSPACE KUNITS                                          00012620
                    C                                                               00012630
                    C *** READ IN TIME, SOURCE, PLUME RISE, TOTAL SOURCE ***        00012640
   ISN 0015               READ  (KUNITS,END=700,ERR  =600) KYR,KMO,KDAY,KHR         00012650
                        &     ,QB,PQB,ZR,QBTOT,PQBTOT                               00012660
   ISN 0016               PARM(6)=QBTOT                                             00012670
   ISN 0017               PARM(7)=PQBTOT                                            00012680
   ISN 0018               GO TO 9000                                                00012690
                    C                                                               00012700
   ISN 0019          600 WRITE (JUNIT,870)                                          00012710
   ISN 0020               GO TO 9000                                                00012720
   ISN 0021          700 WRITE (JUNIT,880)                                          00012730
                    C                                                               00012740
   ISN 0022         9000 RETURN                                                     00012750
                    C     DEBUG SUBCHK                                              00012760
   ISN 0023               END                                                       00012770

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      22 ,PROGRAM SIZE =      998

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                          121K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                          SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                 C                                                                   00012780
  ISN 0002             SUBROUTINE STABIT (V,ESKY,IHR,STAB,ITRAT)                     00012790
                 C                                                                   00012800
                 C.... THIS SUBROUTINE ESTIMATES CONTINUOUS STABILITY CLASSES.       00012810
                 C                                                                   00012820
  ISN 0003             DIMENSION W(5),F(5),START(6,5),X1(5),X2(5),Y3(5),Y4(5)        00012830
  ISN 0004             DIMENSION ISOLAR(24)                                          00012840
                 C                                                                   00012850
  ISN 0005             DATA                                                          00012860
                     *   W/2.0,3.0,5.0,6.0,8.0/,  F/2.0,1.0,2.0,1.0,2.0/             00012870
                     * ,ISOLAR/1,1,1,1,1,1,1,2,2,3,4,4,4,3,3,2,2,2,1,1,1,1,1,1/      00012880
                     * ,X1/2.0,2.5,2.5,3.1,3.2/,  X2/3.0,3.2,3.2,3.3,3.4/            00012890
                     * ,Y3/4.0,4.0,3.8,3.7,3.6/,  Y4/5.0,4.5,4.0,3.9,3.7/            00012900
                     * ,START/0.0,0.5,1.3,2.0,2.5,3.2,0.5,1.3,1.5,2.5,3.2,3.4,1.0,1.5, 00012910
                     * 2.5,3.0,3.3,3.5,5.0,5.0,4.1,3.8,3.6,3.5,6.0,6.0,5.1,4.0,3.8,3.6/ 00012920
                 C                                                                   00012930
                 C.... STAB  = CONTINUOUS STABILITY CLASS, NEUTRAL CONDITION IS 3.5  00012940
                 C     ISKY  = CLOUD COVER (=ESKY)                                   00012950
                 C     V     = AVERAGE WIND SPEED (M/SEC)                            00012960
                 C     W     = END VALUES OF WIND SPEED RANGE                        00012970
                 C     F     = VALUE OF WIND SPEED RANGE INTERVAL                    00012980
                 C     INDEXW= INDEX OF WIND SPEED RANGE                             00012990
                 C     ISOLAR= INDEX OF INSOLATION AS TIME OF A DAY, =1 NIGHT TIME   00013000
                 C              =2 TRANSSTION PERIOD; =3 SLIGHT INSOLATION;          00013010
                 C              =4 MODERATE INSOLATION; =5 STRONG INSOLATION         00013020
                 C          (CURRENT VALUE GIVEN IN DATA ARE FOR MONTH OF FEBRUARY)  00013030
                 C     X1,X2 = STABILITY INDEX OF TRANSITION PERIOD FOR DAY TO NIGHT 00013040
                 C     Y3,Y4 = SAME AS X1,X2 FOR NIGHT TO DAY                        00013050
                 C     START(INDEXW,IRADN) = STABILITY INDEX FOR NIGHT AND DAY TIME. 00013060
                 C     IRADN = INDEX OF SKY CONDITION                                00013070
                 C              =1 STRONG INSOLATION; =2 MODERATE; =3 SLIGHT         00013080
                 C              =4 CLOUDY NIGHT; =5 CLEAR NIGHT                      00013090
                 C                                                                   00013100
                 C     ------------- TAPBE OF INDICES ---------------                00013110
                 C     K=INDEXW :  1     2     3     4     5     6                   00013120
                 C     W(K)     : 2.0   3.0   5.0   6.0   8.0   ...                  00013130
                 C     'DAY & NIGHT TIME'                                            00013140
                 C     START(K,N)                                                    00013150
                 C         N=1  : 0.0   0.5   1.3   2.0   2.5   3.2                  00013160
                 C         N=2  : 0.5   1.3   1.5   2.5   3.2   3.4                  00013170
                 C         N=3  : 1.0   1.5   2.5   3.0   3.3   3.5                  00013180
                 C         N=4  : 5.0   5.0   4.1   3.8   3.6   3.5                  00013190
                 C         N=5  : 6.0   6.0   5.1   4.0   3.8   3.6                  00013200
                 C     'DAY TO NIGHT'                                                00013210
                 C       X1(K)  : 2.0   2.5   2.5   3.1   3.2   ...                  00013220
                 C       X2(K)  : 3.0   3.2   3.2   3.3   3.4   ...                  00013230
                 C     'NIGHT TO DAY'                                                00013240
                 C       Y3(K)  : 4.0   4.0   3.8   3.7   3.6   ...                  00013250
                 C       Y4(K)  : 5.0   4.5   4.0   3.9   3.7   ...                  00013260
                 C                                                                   00013270
  ISN 0006             ISKY=ESKY                                                     00013280
  ISN 0007             IH=IHR+1                                                      00013290
                 C                                                                   00013300
                 C *** FIX INDEX OF WIND SPEED RANGE ***                             00013310
  ISN 0008             DO 100 K=1,5                                                  00013320
  ISN 0009             INDEXW=K                                                      00013330
ISN 0010              P=V-W(K)                                                          00013340
ISN 0011              IF (P.LT.0.0) GO TO 120                                           00013350
ISN 0013          100 CONTINUE                                                          00013360
ISN 0014              INDEXW=6                                                          00013370
ISN 0015          120 CONTINUE                                                          00013380
                C                                                                       00013390
                C *** FIX INDEX OF SKY CONDITION ***                                     00013400
ISN 0016              NHR=ISOLAR(IH)                                                    00013410
ISN 0017              GO TO (210,400,230,240,250),NHR                                   00013420
                C                                                                       00013430
                C.... INDEX FOR NIGHT TIME SKY CONDITION                                00013440
ISN 0018          210 IRADN=5                                                           00013450
ISN 0019              IF (ISKY.GT.4) IRADN=4                                            00013460
ISN 0021              GO TO 300                                                         00013470
                C                                                                       00013480
                C.... INDEX FOR DAY TIME SKY CONDITION                                  00013490
ISN 0022          230 IRADN=3                                                           00013500
ISN 0023              GO TO 300                                                         00013510
ISN 0024          240 IRADN=2                                                           00013520
ISN 0025              IF (ISKY.GT.4) IRADN=3                                            00013530
ISN 0027              GO TO 300                                                         00013540
ISN 0028          250 IRADN=1                                                           00013550
ISN 0029              IF (ISKY.GT.3) IRADN=2                                            00013560
ISN 0031              IF (ISKY.GT.7) IRADN=3                                            00013570
                C                                                                       00013580
                C.... SET ITRAT=0, CURRENT HOUR IS NOT IN TRANSITION PERIOD....         00013590
ISN 0033          300 CONTINUE                                                          00013600
ISN 0034              ITRAT=0                                                           00013610
                C                                                                       00013620
                C      ----------------- DAY OR NIGHT TIME STABILITY -----------------. 00013630
                C                                                                       00013640
ISN 0035              IF (INDEXW.GE.6) GO TO 320                                        00013650
ISN 0037              Q=START(INDEXW,IRADN)                                             00013660
ISN 0038              QP=START(INDEXW+1,IRADN)                                          00013670
ISN 0039              P=V-(W(INDEXW)-F(INDEXW))                                         00013680
ISN 0040              D=QP-Q                                                            00013690
ISN 0041              STAB=Q+D*P/F(INDEXW)                                              00013700
ISN 0042              GO TO 900                                                         00013710
ISN 0043          320 CONTINUE                                                          00013720
ISN 0044              STAB=START(6,IRADN)                                               00013730
ISN 0045              GO TO 900                                                         00013740
                C                                                                       00013750
                C      ----------------- TRANSITION PERIOD STABILITY ------------------00013760
                C                                                                       00013770
ISN 0046          400 CONTINUE                                                          00013780
ISN 0047              IF (INDEXW.GE.6) GO TO 500                                        00013790
ISN 0049              P=V-(W(INDEXW)-F(INDEXW))                                         00013800
                C.... IF ITRAT NOT EQUAL TO 0, PREVIOUS HOUR ALSO IN TRANSITION PERIOD  00013810
ISN 0050              IF (ITRAT.NE.1) GO TO 440                                         00013820
                C                                                                       00013830
                C *** FIRST HOUR OF TRANSIENT PERIUD ***                                 00013840
ISN 0052              IF (IH .LE. 12) GO TO 420                                         00013850
                C                                                                       00013860
                C ... DAY TO NIGHT                                                      00013870
ISN 0054              Q=AMAX1(STAB,X1(INDEXW))                                          00013880
ISN 0055              QP=X2(INDEXW)                                                     00013890
ISN 0056              IF (QP.LE.Q) GO TO 410                                            00013900
ISN 0058              D=QP-Q                                                            00013910
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    ISN 0059          STAB=Q+D*P/F(INDEXW)                                  00013920
    ISN 0060          GO TO 700                                             00013930
    ISN 0061      410 D=3.5-Q                                               00013940
    ISN 0062          STAB=Q+D*P/F(INDEXW)                                  00013950
    ISN 0063          GO TO 700                                             00013960
                C                                                           00013970
                C ... NIGHT TO DAY                                          00013980
    ISN 0064      420 CONTINUE                                              00013990
    ISN 0065          Q=AMIN1(STAB,Y4(INDEXW))                              00014000
    ISN 0066          QP=Y3(INDEXW)                                         00014010
    ISN 0067          IF (QP.GE.Q) GO TO 430                                00014020
    ISN 0069          D=Q-QP                                                00014030
    ISN 0070          STAB=QP+D*P/F(INDEXW)                                 00014040
    ISN 0071          GO TO 700                                             00014050
    ISN 0072      430 D=QP-3.5                                              00014060
    ISN 0073          STAB=3.5+D*P/F(INDEXW)                                00014070
    ISN 0074          GO TO 700                                             00014080
                C                                                           00014090
                C *** SECOND AND THIRD HOURS OF TRANSIENT PERIOD ***         00014100
    ISN 0075      440 CONTINUE                                              00014110
    ISN 0076          IF (IH.LT.12) GO TO 450                               00014120
                C ... DAY TO NIGHT                                          00014130
    ISN 0078          Q=AMAX1(STAB,X2(INDEXW))                              00014140
    ISN 0079          QP=Y3(INDEXW)                                         00014150
    ISN 0080          D=QP-Q                                                00014160
    ISN 0081          STAB=Q+D*P/F(INDEXW)                                  00014170
    ISN 0082          GO TO 700                                             00014180
                C ... NIGHT TO DAY                                          00014190
    ISN 0083      450 CONTINUE                                              00014200
    ISN 0084          Q=X2(INDEXW)                                          00014210
    ISN 0085          QP=AMIN1(STAB,Y3(INDEXW))                             00014220
    ISN 0086          D=QP-Q                                                00014230
    ISN 0087          STAB=Q+D*P/F(INDEXW)                                  00014240
    ISN 0088          GO TO 700                                             00014250
    ISN 0089      500 STAB=3.5                                              00014260
                C                                                           00014270
                C.... CURRENT HOUR IS IN TRANSITION PERIOD, SET (ITRAT.NE.0)  00014280
    ISN 0090      700 CONTINUE                                              00014290
    ISN 0091          ITRAT=99                                              00014300
                C                                                           00014310
    ISN 0092      900 CONTINUE                                              00014320
    ISN 0093          RETURN                                                00014330
                CC     DEBUG INIT                                           00014340
                C     DEBUG SUBCHK                                          00014350
    ISN 0094          END                                                   00014360

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       93 ,PROGRAM SIZE =     1372

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                              113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                              OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                   00000010
  ISN 0002              SUBROUTINE STNCON (CC,IOBS,ICAL,KOBS,KCAL,ITOBS,NS,NSX        00000020
                       *                      ,IM,JM,XS,YS,JXS,JYS)                   00000030
                  C                                                                   00000040
                  C.... THIS SUBROUTINE COMPUTES CONCENTRATION VALUES AT RAMS         00000050
                  C     STATION. IT ALSO COMPUTES SPATIAL AND TIME AVERAGE FOR        00000060
                  C     COMPUTED AND OBSERVED SO2 CONCENTRATIONS.                     00000070
                  C                                                                   00000080
  ISN 0003              DIMENSION                                                     00000090
                       *          CC(IM,JM),IOBS(NSX),ICAL(NSX),KOBS(NSX)             00000100
                       *          ,KCAL(NSX),ITOBS(NSX)                               00000110
                       *          ,XS(NS),YS(NS),JXS(NS),JYS(NS)                      00000120
                  C                                                                   00000130
  ISN 0004              COMMON    /AADATA/                                            00000140
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW       00000150
                       *  ,IYR,IMO,IDAY,IHR,ITM,IT4HR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC  00000160
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                00000170
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00000180
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN          00000190
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ   00000200
                  C                                                                   00000210
  ISN 0005              N=0                                                           00000220
  ISN 0006              IOBS(NSX)=0                                                   00000230
  ISN 0007              ICAL(NSX)=0                                                   00000240
  ISN 0008              DO 200 L=1,NS                                                 00000250
  ISN 0009              IOBS(L)=RAMS(5,L)+0.5                                         00000260
  ISN 0010              IXS=JXS(L)                                                    00000270
  ISN 0011              IYS=JYS(L)                                                    00000280
                  C                                                                   00000290
  ISN 0012              IF ((IXS.GT.1).AND.(IXS.LT.IM)) GO TO 100                     00000300
  ISN 0014              ICAL(L)=0.5*(CC(IXS,IYS)+CC(IXS,IYS+1))                       00000310
  ISN 0015              GO TO 110                                                     00000320
  ISN 0016          100 CONTINUE                                                      00000330
  ISN 0017              IF ((IYS.GT.1).AND.(IYS.LT.JM)) GO TO 120                     00000340
  ISN 0019              ICAL(L)=0.5*(CC(IXS,IYS)+CC(IXS+1,IYS))                       00000350
  ISN 0020          110 CONTINUE                                                      00000360
  ISN 0021              IF (IOBS(L).GT.5000) GO TO 200                                00000370
  ISN 0023              GO TO 130                                                     00000380
                  C.... BI-LINEAR INTERPOLATION                                       00000390
  ISN 0024          120 CONTINUE                                                      00000400
  ISN 0025              P=XS(L)-IXS+0.5                                               00000410
  ISN 0026              Q=YS(L)-IYS+0.5                                               00000420
  ISN 0027              IF (P.GE.0.) GO TO 122                                        00000430
  ISN 0029              P=P+1.0                                                       00000440
  ISN 0030              IXS=IXS-1                                                     00000450
  ISN 0031          122 CONTINUE                                                      00000460
  ISN 0032              IF (Q.GE.0.) GO TO 124                                        00000470
  ISN 0034              Q=Q+1.0                                                       00000480
  ISN 0035              IYS=IYS-1                                                     00000490
  ISN 0036          124 CONTINUE                                                      00000500
  ISN 0037              R=(1.-P)*(1.-Q)*CC(IXS,IYS)+P*(1.-Q)*CC(IXS+1,IYS)            00000510
                       *        +Q*(1.-P)*CC(IXS,IYS+1)+P*Q*CC(IXS+1,IYS+1)           00000520
  ISN 0038              ICAL(L)=R+0.5                                                 00000530
  ISN 0039              IF (IOBS(L).GT.5000) GO TO 200                                00000540
                  C                                                                   00000550
                  C.... SPATIAL AVERAGE                                               00000560
  ISN 0041            IOBS(NSX)=IOBS(NSX)+IOBS(L)                                    00000570
  ISN 0042            ICAL(NSX)=ICAL(NSX)+ICAL(L)                                    00000580
  ISN 0043            N=N+1                                                          00000590
  ISN 0044        130 CONTINUE                                                       00000600
                C                                                                    00000610
                C.... 24 HOUR AVERAGE                                                00000620
  ISN 0045            KOBS(L)=KOBS(L)+IOBS(L)                                        00000630
  ISN 0046            KCAL(L)=KCAL(L)+ICAL(L)                                        00000640
  ISN 0047            ITOBS(L)=ITOBS(L)+1                                            00000650
  ISN 0048        200 CONTINUE                                                       00000660
  ISN 0049            IF(N .EQ. 0) GO TO 210                                         00000670
  ISN 0051            IOBS(NSX)=IOBS(NSX)/N                                          00000680
  ISN 0052            ICAL(NSX)=ICAL(NSX)/N                                          00000690
  ISN 0053            KOBS(NSX)=KOBS(NSX)+IOBS(NSX)                                  00000700
  ISN 0054            KCAL(NSX)=KCAL(NSX)+ICAL(NSX)                                  00000710
  ISN 0055            ITOBS(NSX)=ITOBS(NSX)+1                                        00000720
  ISN 0056        210 CONTINUE                                                       00000730
                C                                                                    00000740
  ISN 0057            IF (IHR.NE.0) RETURN                                           00000750
                C                                                                    00000760
  ISN 0059            DO 300 L=1,NSX                                                 00000770
  ISN 0060            KOBS(L)=KOBS(L)/ITOBS(L)                                       00000780
  ISN 0061            KCAL(L)=KCAL(L)/ITOBS(L)                                       00000790
  ISN 0062        300 CONTINUE                                                       00000800
                C                                                                    00000810
  ISN 0063            RETURN                                                         00000820
                C     DEBUG SUBCHK                                                   00000830
  ISN 0064            END                                                            00000840

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      63 ,PROGRAM SIZE =     1696

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                            OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                         C                                                               00000850
   ISN 0002                    SUBROUTINE TIMEX (NMONDY)                                 00000860
                         C                                                               00000870
                         C.... THIS ROUTINE FIX INDICES OF SIMULATION AND REAL TIME.     00000880
                         C                                                               00000890
   ISN 0003                    DIMENSION NMONDY(12)                                      00000900
   ISN 0004                    DATA NDAYHR/24/,NHRSEC/3600/                              00000910
                         C                                                               00000920
   ISN 0005                    COMMON    /AADATA/                                        00000930
                              *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW   00000940
                              *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC 00000950
                              *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                            00000960
                              *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00000970
                              *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN      00000980
                              *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ 00000990
                         C                                                               00001000
                         C *** FIX SIMULATION TIME INDICIES ***                          00001010
                         C                                                               00001020
   ISN 0006                    TM=TM+DT                                                  00001030
   ISN 0007                    ITM=TM                                                    00001040
   ISN 0008                    ITSTEP=ITSTEP+1                                           00001050
   ISN 0009                    ITMHR=ITM/NHRSEC*NHRSEC                                   00001060
   ISN 0010                    TSEC=TM-ITMHR                                             00001070
   ISN 0011                    ITSEC=TSEC                                                00001080
                         C                                                               00001090
                         C *** FIX INDICIES OF MONTH, DAY AND HOUR ***                   00001100
                         C                                                               00001110
   ISN 0012                    IF (ITM .NE.  ITMHR) GO TO 110                            00001120
   ISN 0014                    ITOTHR=ITOTHR+1                                           00001130
   ISN 0015                    IHR=IHR+1                                                 00001140
   ISN 0016                    IF ( IHR .LT. NDAYHR) GO TO 110                           00001150
   ISN 0018                    IDAY= IDAY+1                                              00001160
   ISN 0019                    IHR= 0                                                    00001170
   ISN 0020                    IF ( IDAY .LE. NMONDY(IMO)) GO TO 110                     00001180
   ISN 0022                    IMO=IMO+1                                                 00001190
   ISN 0023                    IDAY=1                                                    00001200
   ISN 0024                    IF ( IMO .LE. 12) GO TO 110                               00001210
   ISN 0026                    IYR=IYR+1                                                 00001220
   ISN 0027                    IMO=1                                                     00001230
   ISN 0028                110 CONTINUE                                                  00001240
                         C                                                               00001250
   ISN 0029                    RETURN                                                    00001260
                         C     DEBUG SUBCHK                                              00001270
   ISN 0030                    END                                                       00001280

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      29 ,PROGRAM SIZE =      514

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                 121K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                    OS/360  FORTRAN H

       COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                          SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                    C                                                                      00001290
  ISN 0002                SUBROUTINE UVFLUX ( CP1,  C,U,UZF,DX,DY,RDX,RDY,Z,EK,FK,         00001300
                        *                         IM,JM,KM,IMJM,IJKM,LX,LY,IJKN)           00001310
                    C                                                                      00001320
                    C.... THIS SUBROUTINE COMPUTES THE HORIZONTAL ADVECTION TERMS OF       00001330
                    C....  CONCENTRATION EQUATION.                                         00001340
                    C.... THIS PROGRAM CAN BE USED FOR X AND Y ADVECTION BY INTERCHANGING  00001350
                    C....  VARIABLES ARGUMENTS IN CALL STATEMENT.                          00001360
                    C.... THE SECOND ORDER CENTRAL FINITE DIFFERENCE SCHEME IS USED.       00001370
                    C.... THE 3-D VARIABLE A(I,J,K) IS REPRESENTED BY VECTOR A(IJK).       00001380
                    C                                                                      00001390
  ISN 0003                DIMENSION                                                        00001400
                        *        CP1(IJKM),C(IJKM),U(IJKN),UZF(KM)                         00001410
                        *     ,DX(IM),DY(JM),RDX(IM),RDY(JM),Z(KM)                         00001420
                        *     ,EK(IM) ,FK(IM),DTDXI(40)                                    00001430
                    C                                                                      00001440
  ISN 0004                COMMON    /AADATA/                                               00001450
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW           00001460
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC      00001470
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                    00001480
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00001490
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN              00001500
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ       00001510
                    C                                                                      00001520
                    C *** COEFFICIENTS OF FINITE DIFF. FORMULA ***                         00001530
  ISN 0005                IM11=IM-1                                                        00001540
  ISN 0006                JM11=JM-1                                                        00001550
  ISN 0007                EK(1)=0.5                                                        00001560
  ISN 0008                FK(IM)=0.5                                                       00001570
  ISN 0009                DO 10 I=2,IM                                                     00001580
  ISN 0010                FK(I-1)=1.0/(1.0+RDX(I))                                         00001590
  ISN 0011             10 EK(I)= RDX(I)*FK(I-1)                                            00001600
  ISN 0012                KK=0                                                             00001610
  ISN 0013                DO 30 I=1,IM                                                     00001620
  ISN 0014             30 DTDXI(I)=DT/DX(I)                                                00001630
                    C                                                                      00001640
                    C *** COMPUTE ADVECTION ***                                            00001650
  ISN 0015                KN=IJKN/IMJM                                                     00001660
  ISN 0016                KN1=KN+1                                                         00001670
  ISN 0017                KKVMAX=(KN-1)*IMJM                                               00001680
  ISN 0018                KKV=-IMJM                                                        00001690
                    C                                                                      00001700
  ISN 0019                DO 500 K= 2,KM                                                   00001710
  ISN 0020                KK= KK+ IMJM                                                     00001720
  ISN 0021                KKV=KKV+IMJM                                                     00001730
                    C     FOR K GT KN1, THE WIND ARE THE SAME AS K=KN1.                    00001740
  ISN 0022                IF ( K .GT. KN1) KKV=KKVMAX                                      00001750
  ISN 0024                ZK= Z(K)                                                         00001760
                    C                                                                      00001770
                    C *** PROCESS INTERIOR GRID POINTS ***                                 00001780
  ISN 0025                JJ=-LY                                                           00001790
  ISN 0026                DO 200 J= 1,JM                                                   00001800
  ISN 0027                JJ= JJ+LY                                                        00001810
  ISN 0028                JLY=JJ                                                           00001820
  ISN 0029                ILX= -LX                                                         00001830
  ISN 0030                DO 150 I= 1,IM11                                                 00001840
ISN 0031          ILX= ILX+ LX                                                    00001850
ISN 0032          IJ= 1+ ILX+JLY                                                  00001860
ISN 0033          IJK = IJ+KK                                                     00001870
ISN 0034          IJKV=IJ+KKV                                                     00001880
            C     ALF= DTDX*(U(IJKV)+U(IJKV+LX))                                  00001890
ISN 0035          ALF= DTDXI(I)*U(IJKV)*UZF(K)                                    00001900
ISN 0036          AF1= ALF                                                        00001910
ISN 0037          A3= AF1*AF1                                                     00001920
ISN 0038          CIJK= C(IJK)                                                    00001930
ISN 0039          CIJK1= C(IJK+LX)                                                00001940
ISN 0040          CPIJK =CP1(IJK)                                                 00001950
ISN 0041          CPIJK1=CP1(IJK+LX)                                              00001960
ISN 0042          T1= CIJK+CIJK1                                                  00001970
ISN 0043          T3= CIJK-CIJK1                                                  00001980
            C.... UF IS FLUX FROM ONE GRID POINT TO ANOTHER.                      00001990
ISN 0044          UF=AF1*T1+A3*T3                                                 00002000
ISN 0045          CCIJK =CPIJK -UF*EK(I)                                          00002010
ISN 0046          CCIJK1=CPIJK1+UF*EK(I)                                          00002020
            C.... CHECK TOTAL FLUX IS NOT EXCEED THE MASS IN UPWIND GRID          00002030
            C....  CELL. IF EXCEEDED, READJUST THE FLUX TO PREVENT THE            00002040
            C....  VALUES OF C TO BECOME NEGATIVE DUE TO TRUNCATION ERROR.        00002050
ISN 0047          IF ((CCIJK .GE. 0.0) .AND. (CCIJK1 .GE. 0.0)) GO TO 110         00002060
ISN 0049          IF ( CCIJK .LT. 0.) UF=CPIJK/EK(I)                              00002070
ISN 0051          IF ( CCIJK1 .LT. 0.0) UF=-CPIJK1/EK(I)                          00002080
ISN 0053          CCIJK =CPIJK -UF*EK(I)                                          00002090
ISN 0054          CCIJK1=CPIJK1+UF*EK(I)                                          00002100
ISN 0055      110 CP1(IJK)=CCIJK                                                  00002110
ISN 0056          CP1(IJK+LX)=CCIJK1                                              00002120
ISN 0057      150 CONTINUE                                                        00002130
ISN 0058      200 CONTINUE                                                        00002140
            C                                                                     00002150
            C *** PROCESS INFLOW AND OUTFLOW BOUNDARY GRID POINTS ***             00002160
            C                                                                     00002170
ISN 0059          DO 400 I= 1, IM, IM11                                           00002180
ISN 0060          ILX= (I-1)*LX                                                   00002190
ISN 0061          JLY= -LY                                                        00002200
ISN 0062          DO 350 J= 1, JM                                                 00002210
ISN 0063          JLY= JLY+ LY                                                    00002220
ISN 0064          IJ= 1+ ILX+JLY                                                  00002230
ISN 0065          IJK = IJ+KK                                                     00002240
ISN 0066          IJKV=IJK-IMJM                                                   00002250
ISN 0067          IF ( K .GT. KN1) IJKV=IJ+KKVMAX                                 00002260
ISN 0069          IF ( I .EQ. IM) GO TO 320                                       00002270
            C     ALF= DTDX*(U(IJKV)+U(IJKV+LX))                                  00002280
ISN 0071          ALF=DTDXI(I)*U(IJKV)*UZF(K)                                     00002290
ISN 0072          IF ( ALF .GT. 0.0 ) GO TO 330                                   00002300
ISN 0074          CIJK=C(IJK)                                                     00002310
ISN 0075          CIJK1=C(IJK+LX)                                                 00002320
ISN 0076          T3=CIJK-CIJK1                                                   00002330
ISN 0077          UF= ALF*T3                                                      00002340
ISN 0078          IF (CIJK1 .LT. UF) UF=CIJK1                                     00002350
ISN 0080          CP1(IJK)= CIJK+UF                                               00002360
ISN 0081          GO TO 330                                                       00002370
ISN 0082      320 CONTINUE                                                        00002380
            C     ALF= DTDX*(U(IJKV)+U(IJKV-LX))                                  00002390
ISN 0083          ALF=DTDXI(I)*U(IJKV)*UZF(K)                                     00002400
ISN 0084          IF ( ALF .LT. 0.0 ) GO TO 330                                   00002410
ISN 0086          CIJK=C(IJK)                                                     00002420
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   ISN 0087               CIJK1=C(IJK-LX)                                                      00002430
   ISN 0088               T3=CIJK1-CIJK                                                        00002440
   ISN 0089               UF= ALF*T3                                                           00002450
   ISN 0090               IF (CIJK1 .LT. UF) UF=CIJK1                                          00002460
                    C     OUTFLOW BOUNDRY ,FIRST ORDER UPSTREAM SCHEME IS USED .....           00002470
                    C     NOTE THAT CIJK IS OLD TIME C ...                                     00002480
   ISN 0092               CP1(IJK)= CIJK+UF                                                    00002490
   ISN 0093           330 CONTINUE                                                             00002500
   ISN 0094               IF ( CP1(IJK) .LT. 0.0) CP1(IJK)=0.0                                 00002510
   ISN 0096           350 CONTINUE                                                             00002520
   ISN 0097           400 CONTINUE                                                             00002530
                    C                                                                          00002540
   ISN 0098           500 CONTINUE                                                             00002550
                    C                                                                          00002560
   ISN 0099               RETURN                                                               00002570
                    C     DEBUG SUBCHK                                                         00002580
   ISN 0100               END                                                                  00002590

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       99 ,PROGRAM SIZE =     2228

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                          109K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C                                                                    00002600
   ISN 0002              SUBROUTINE UVINTP (UU,VV,IN,JN,U,V,IM,JM,DX,DY,DELX)            00002610
                   C                                                                    00002620
                   C.... THIS ROUTINE OBTAINS THE SURFACE WIND FIELD AT NEMERICAL        00002630
                   C      GRIDS BY INTERPOLATING ANALYZED FIELD AT WIND GRIDS.           00002640
                   C.... THE INTERPOLATION SCHEME IS BI-LINEAR.                          00002650
                   C     DELX = DIMENSION OF WIND GRID.                                  00002660
                   C                                                                    00002670
   ISN 0003              DIMENSION UU(IN,JN),VV(IN,JN),U(IM,JM),V(IM,JM)                 00002680
                        &          ,DX(IM),DY(JM)                                        00002690
                   C                                                                    00002700
   ISN 0004              IF ((IM.LT.IN).OR.(JM.LT.JN)) RETURN                            00002710
                   C                                                                    00002720
   ISN 0006              DELXI=0.001/DELX                                                00002730
   ISN 0007              YJ=-DY(1)*0.5                                                   00002740
   ISN 0008              DO 100  J=1,JM                                                  00002750
   ISN 0009              YJ=YJ+DY(J)                                                     00002760
   ISN 0010              YW=YJ*DELXI+1.0001                                              00002770
   ISN 0011              JW=YW                                                           00002780
   ISN 0012              Q=YW-JW                                                         00002790
   ISN 0013              Q1=1.-Q                                                         00002800
   ISN 0014              XI=-DX(1)*0.5                                                   00002810
   ISN 0015              DO 100 I=1,IM                                                   00002820
   ISN 0016              XI=XI+DX(I)                                                     00002830
   ISN 0017              XW=XI*DELXI+1.0001                                              00002840
   ISN 0018              IW=XW                                                           00002850
   ISN 0019              P=XW-IW                                                         00002860
   ISN 0020              P1=1.-P                                                         00002870
   ISN 0021              D1=P1*Q1                                                        00002880
   ISN 0022              D2= P*Q1                                                        00002890
   ISN 0023              D3=P1* Q                                                        00002900
   ISN 0024              D4= P* Q                                                        00002910
   ISN 0025              U(I,J)=D1*UU(IW,JW)+D2*UU(IW+1,JW)+D3*UU(IW,JW+1)+D4*UU(IW+1,JW+1)00002920
   ISN 0026              V(I,J)=D1*VV(IW,JW)+D2*VV(IW+1,JW)+D3*VV(IW,JW+1)+D4*VV(IW+1,JW+1)00002930
   ISN 0027          100 CONTINUE                                                        00002940
                   C                                                                    00002950
   ISN 0028              RETURN                                                          00002960
                   C     DEBUG SUBCHK                                                    00002970
   ISN 0029              END                                                             00002980
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       28 ,PROGRAM SIZE =      1220

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  121K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                              OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C
  ISN 0002               SUBROUTINE UVZF (U,V,U1,V1,UZF,VZF,WZF,Z,IM,JM,KM,KN,LX)
                   C
                   C.... THIS SUBROUTINE COMPUTES VERTICAL WIND PROFILE.
                   C
  ISN 0003               DIMENSION U(IM,JM,KN),V(IM,JM,KN),U1(IM,JM),V1(IM,JM)
  ISN 0004               DIMENSION Z(KM),UZF(KM),VZF(KM),WZF(KM)
                   C
  ISN 0005               COMMON    /AADATA/
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ
                   C
                   C
                   C
                   C
                   C.... COMPUTE WIND POWER LAW CONSTANT AND WIND ANGLE CHANGE.
  ISN 0006               UVP=PARM(1)
  ISN 0007               THETAP=PARM(2)
  ISN 0008               P=PMIN
  ISN 0009               IF ((UVP.LE.0.5).OR.(UVP.GE.30.)) GO TO 10
  ISN 0011               P=ALOG(UVP/PARM(1))*0.8
  ISN 0012               IF ((PARM(1).GE.6.).AND.(P.GT.0.3)) P=0.3
  ISN 0014            10 CONTINUE
  ISN 0015               IF (P.LT.PMIN) P=PMIN
  ISN 0017               IF (P.GT.PMAX) P=PMAX
  ISN 0019               DTHETA=THETAP-PARM(2)
  ISN 0020               IF ((THETAP.GT.360.).OR.(PARM(2).GT.360.)) DTHETA=0.
  ISN 0022               IF (ABS(DTHETA).GT.180.) DTHETA=DTHETA-SIGN(1.,DTHETA)*360.
  ISN 0024               IF (ABS(DTHETA).GT.25.) DTHETA=25.*SIGN(1.,DTHETA)
                   C
                   C
  ISN 0026               GO TO (100,200,300),LWIND
                   C
                   C     ------------------------- LWIND=1 -------------------------.
                   C.... LWIND=1, ALL UPPER WIND ABOVE HEIGHT HP ARE SAME AS OBSERED.
  ISN 0027           100 CONTINUE
  ISN 0028               AHPZS=1.0/ALOG(HP/HS)
  ISN 0029               DO 190 K=2,KN
  ISN 0030               ZK=Z(K+1)
  ISN 0031               IF (ZK.GE.HP) ZK=HP
  ISN 0033               DO 190 J=1,JM
  ISN 0034               DO 190 I=1,IM
  ISN 0035               UK=U1(I,J)
  ISN 0036               VK=V1(I,J)
  ISN 0037               IF( LX .EQ. 1) GO TO 110
  ISN 0039               UK=V1(I,J)
  ISN 0040               VK=U1(I,J)
  ISN 0041           110 CONTINUE
                   C
  ISN 0042               CALL       WINDER     ( UK,VK,UV,THETA,1)
  ISN 0043               IF ( UV .EQ.  0.0) GO TO 130
  ISN 0045               IF ( UVP .LE. UV) GO TO 150
ISN 0047          P = ALOG( UVP/UV )*AHPZS                                      00003550
ISN 0048          UVZ= UV*(ZK/HS)**P                                            00003560
ISN 0049          DTHETA= THETAP- THETA                                         00003570
            C.... AVOID DTHET GT 180. DEG                                       00003580
ISN 0050          IF ( ABS (DTHETA) .GT. 180.) DTHETA=DTHETA-SIGN(1.,DTHETA)*360.  00003590
ISN 0052          THETAZ= THETAP-(HP-ZK)/(HP- HS)* DTHETA                       00003600
            C                                                                   00003610
ISN 0053      120 CALL       WINDER     (UK,VK,UVZ,THETAZ, 2)                   00003620
ISN 0054          IF ( LX .EQ. 1) GO TO 150                                     00003630
ISN 0056          UX= UK                                                        00003640
ISN 0057          UK= VK                                                        00003650
ISN 0058          VK= UX                                                        00003660
ISN 0059          GO TO 150                                                     00003670
            C.... IF UV=0., PARABOLIC PROFILE IS ASSUMED                        00003680
ISN 0060      130 ZPS= (ZK-HS)/(HP-HS)                                          00003690
ISN 0061          UVZ= UVP*(1.0- ZPS*ZPS)                                       00003700
ISN 0062          THETAZ= THETAP                                                00003710
ISN 0063          GO TO 120                                                     00003720
ISN 0064      150 CONTINUE                                                      00003730
ISN 0065          U(I,J,K)=UK                                                   00003740
ISN 0066          V(I,J,K)=VK                                                   00003750
ISN 0067      190 CONTINUE                                                      00003760
ISN 0068          GO TO 400                                                     00003770
            C                                                                   00003780
            C      -------------------------- LWIND=2 --------------------------.  00003790
            C                                                                   00003800
            C.... LWIND=2 , UPPER WIND HAS SAME DIRECTION AS SURFACE WIND.      00003810
            C       THE WIND SPEED ARE COMPUTED BY POWER LOW.                   00003820
ISN 0069      200 CONTINUE                                                      00003830
ISN 0070          IF(KN .GT. 1) GO TO 230                                       00003840
ISN 0072          DO 220 K=2,KM                                                 00003850
ISN 0073          ZK=Z(K)                                                       00003860
ISN 0074          IF(ZK .GT. HP) ZK=HP                                          00003870
ISN 0076          UZF(K)=(ZK/HS)**P                                             00003880
ISN 0077      220 CONTINUE                                                      00003890
ISN 0078          GO TO 400                                                     00003900
ISN 0079      230 CONTINUE                                                      00003910
ISN 0080          DO 290 K=2,KN                                                 00003920
ISN 0081          ZK=Z(K+1)                                                     00003930
ISN 0082          ZKP=(ZK/HS)**P                                                00003940
ISN 0083          DO 290 J=1,JM                                                 00003950
ISN 0084          DO 290 I=1,IM                                                 00003960
ISN 0085          U(I,J,K)=U1(I,J)*ZKP                                          00003970
ISN 0086          V(I,J,K)=V1(I,J)*ZKP                                          00003980
ISN 0087      290 CONTINUE                                                      00003990
ISN 0088          GO TO 400                                                     00004000
            C                                                                   00004010
            C     ------------------------- LWIND=3 -------------------------.  00004020
            C                                                                   00004030
            C.... LWIND=3, UPPER WIND HAS EQUAL ANGLE CHANGE AS OBSERVED DATA.  00004040
ISN 0089      300 CONTINUE                                                      00004050
ISN 0090          DO 390 K=2,KN                                                 00004060
ISN 0091          ZK=Z(K+1)                                                     00004070
ISN 0092          ZKP=(ZK/HS)**P                                                00004080
ISN 0093          ZKTHE=(ZK-HS)/(HP-HS)                                         00004090
ISN 0094          DO 390 J=1,JM                                                 00004100
ISN 0095          DO 390 I=1,IM                                                 00004110
ISN 0096          U1IJ=U1(I,J)                                                  00004120
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   ISN 0097             V1IJ=V1(I,J)                                                        00004130
                  C                                                                         00004140
   ISN 0098             CALL     WINDER     (U1IJ,V1IJ,UV1,THETA1,1)                        00004150
   ISN 0099             UVZK=UV1*ZKP                                                        00004160
   ISN 0100             THETAZ= THETA1+ ZKTHE*DTHETA                                        00004170
                  C                                                                         00004180
   ISN 0101             CALL     WINDER     (UK,VK,UVZK,THETAZ,2)                           00004190
   ISN 0102             U(I,J,K)= UK                                                        00004200
   ISN 0103             V(I,J,K)= VK                                                        00004210
   ISN 0104         390 CONTINUE                                                            00004220
   ISN 0105         400 CONTINUE                                                            00004230
                  C                                                                         00004240
   ISN 0106             RETURN                                                              00004250
                  C     DEBUG SUBCHK                                                        00004260
   ISN 0107             END                                                                 00004270
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =     106 ,PROGRAM SIZE =     2706

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                         97K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                      00004280
   ISN 0002             SUBROUTINE WINDER ( U, V, UV, THETA, I)                          00004290
                  C                                                                      00004300
                  C.... THIS SUBROUTINE CONVERTS WIND VECTOR TO COMPONENT OR             00004310
                  C     WIND COMPONENTS TO VECTOR, U=E-W WIND,V=N-S WIND,                00004320
                  C     UV=WIND SPEED, THETA=WIND DIRECTION.IN DEG....                   00004330
                  C.... I=1 CONVERT  U,V TO UV, THETA IN DEG                             00004340
                  C.... I=2 CONVERT UV,THETA TO U,V                                      00004350
                  C                                                                      00004360
   ISN 0003             DATA PAIDEG /57.295776/                                          00004370
                  C.... PAIDEG=180./3.1416                                               00004380
                  C                                                                      00004390
   ISN 0004             IF ( I .GT. 1) GO TO 100                                         00004400
   ISN 0006             UV= SQRT (U*U+V*V)                                               00004410
   ISN 0007             IF (UV .EQ. 0.0) GO TO 20                                        00004420
   ISN 0009             THETA = ATAN2 (-U,-V)*PAIDEG                                     00004430
   ISN 0010             IF (THETA .LT. 0.0) THETA= THETA +360.0                          00004440
   ISN 0012             RETURN                                                           00004450
                  C                                                                      00004460
   ISN 0013          20 THETA=0.0                                                        00004470
   ISN 0014             RETURN                                                           00004480
                  C                                                                      00004490
   ISN 0015         100 ATHETA= THETA/PAIDEG                                             00004500
   ISN 0016             U= -UV*SIN(ATHETA)                                               00004510
   ISN 0017             V= -UV*COS(ATHETA)                                               00004520
                  C                                                                      00004530
   ISN 0018             RETURN                                                           00004540
                  C     DEBUG SUBCHK                                                     00004550
   ISN 0019             END                                                              00004560
*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      18 ,PROGRAM SIZE =       564

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  125K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                   OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C                                                                  00004570
  ISN 0002               SUBROUTINE WINDGR (U1,V1,UU,VV,NEAR,USTN,VSTN,XSUTM,YSUTM    00004580
                        &                   ,IUTM,JUTM,DX,DY,IM,JM,IN,JN,NS)          00004590
                   C                                                                  00004600
                   C.... THIS ROUTINE GENERATES WHOLE WIND FIELD FROM WIND DATA MEASURED  00004610
                   C     AT THE STATIONS.                                             00004620
                   C                                                                  00004630
  ISN 0003               DIMENSION U1(IM,JM),V1(IM,JM),UU(IN,JN),VV(IN,JN),NEAR(IN,JN)  00004640
                        &          ,USTN(NS),VSTN(NS),XSUTM(NS),YSUTM(NS)             00004650
                        &          ,IUTM(IM),JUTM(JM),DX(IM),DY(JM)                   00004660
                   C                                                                  00004670
  ISN 0004               COMMON    /AADATA/                                           00004680
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW      00004690
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC 00004700
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                               00004710
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00004720
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN         00004730
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UO,PHIFHZ,HFZ  00004740
                   C                                                                  00004750
  ISN 0005               IF ((IN.GT.IM).OR.(JN.GT.JM)) RETURN                         00004760
                   C                                                                  00004770
                   C *** KWIND = 3  UNIFORMED WIND FIELD.                             00004780
  ISN 0007               IF (KWIND.NE.3) GO TO 200                                    00004790
  ISN 0009               UVS=PARM(1)                                                  00004800
  ISN 0010               THS=PARM(2)                                                  00004810
                   C                                                                  00004820
  ISN 0011               CALL     WINDER     (USTA,VSTA,UVS,THS,2)                    00004830
                   C                                                                  00004840
  ISN 0012               DO 100 J=1,JM                                                00004850
  ISN 0013               DO 100 I=1,IM                                                00004860
  ISN 0014               U1(I,J)=USTA                                                 00004870
  ISN 0015               V1(I,J)=VSTA                                                 00004880
  ISN 0016           100 CONTINUE                                                     00004890
  ISN 0017               RETURN                                                       00004900
                   C                                                                  00004910
                   C *** KWIND = 4  VARIABLE WIND FIELD. ***                          00004920
                   C.... WEIGHTED INTERPOLATION SCHEME IS USED.                       00004930
  ISN 0018           200 CONTINUE                                                     00004940
  ISN 0019               IF (KWIND.NE.4) RETURN                                       00004950
                   C                                                                  00004960
                   C.... SPECIFY WIND GRID, RADIUS OF INFLUENCE AND FIND A NEAREST    00004970
                   C      STATION TO WIND GRID (I,J)                                  00004980
  ISN 0021               IF (ITM.NE.0) GO TO 300                                      00004990
  ISN 0023               IDELX=(IUTM(IM)-IUTM(1)+0.001*DX(IM))/(IN-1)+0.1             00005000
  ISN 0024               DELX=IDELX                                                   00005010
  ISN 0025               IDELY=(JUTM(JM)-JUTM(1)+0.001*DY(JM))/(JN-1)+0.1             00005020
  ISN 0026               DELY=IDELY                                                   00005030
  ISN 0027               IF (DELX.LT.DELY) DELX=DELY                                  00005040
  ISN 0029               RTEST=(2.*DELX)**2                                           00005050
  ISN 0030               IRAD=2                                                       00005060
  ISN 0031               DO 250 J=1,JN                                                00005070
  ISN 0032               DYB=(J-1)*DELX+JUTM(1)                                       00005080
  ISN 0033               DO 250 I=1,IN                                                00005090
  ISN 0034               DXB=(I-1)*DELX+IUTM(1)                                       00005100
  ISN 0035               SDIST=1200.                                                  00005110
  ISN 0036               DO 230 K=1,NS                                                00005120
ISN 0037          DDX=DXB-XSUTM(K)                                                 00005130
ISN 0038          DDY=DYB-YSUTM(K)                                                 00005140
ISN 0039          DISTR=DDX*DDX+DDY*DDY                                            00005150
ISN 0040          IF (DISTR.GT.SDIST) GO TO 230                                    00005160
ISN 0042          SDIST=DISTR                                                      00005170
ISN 0043          KK=K                                                             00005180
ISN 0044      230 CONTINUE                                                         00005190
ISN 0045          NEAR(I,J)=KK                                                     00005200
ISN 0046      250 CONTINUE                                                         00005210
            C                                                                      00005220
            C *** COMPUTE U AND V FROM OBSERVED UBAR AND THETA AT STATION.         00005230
ISN 0047      300 CONTINUE                                                         00005240
ISN 0048          DO 310 K=1,NS                                                    00005250
ISN 0049          UVS=RAMS(1,K)                                                    00005260
ISN 005C          THS=RAMS(2,K)                                                    00005270
ISN 0051          USTN(K)=99.9                                                     00005280
ISN 0052          VSTN(K)=99.9                                                     00005290
ISN 0053          IF ((UVS.GE.50.).OR.(THS.GT.360.)) GO TO 310                     00005300
            C                                                                      00005310
ISN 0055          CALL     WINDER     (USTA,VSTA,UVS,THS,2)                        00005320
            C                                                                      00005330
ISN 0056          USTN(K)=USTA                                                     00005340
ISN 0057          VSTN(K)=VSTA                                                     00005350
ISN 0058      310 CONTINUE                                                         00005360
            C                                                                      00005370
            C *** OBTAIN INITIAL GUESS FIELD ***                                    00005380
ISN 0059          DO 400 J=1,JN                                                    00005390
ISN 0060          DO 400 I=1,IN                                                    00005400
ISN 0061          KK=NEAR(I,J)                                                     00005410
ISN 0062          IF (USTN(KK).LT.50.) GO TO 380                                   00005420
ISN 0064          DXB=(I-1)*DELX+IUTM(1)                                           00005430
ISN 0065          DYB=(J-1)*DELX+JUTM(1)                                           00005440
ISN 0066          SDIST=1200.                                                      00005450
ISN 0067          DO 350 K=1,NS                                                    00005460
ISN 0068          DDX=DXB-XSUTM(K)                                                 00005470
ISN 0069          DDY=DYB-YSUTM(K)                                                 00005480
ISN 0070          DISTR=DDX*DDX+DDY*DDY                                            00005490
ISN 0071          IF (DISTR.GT.SDIST) GO TO 350                                    00005500
ISN 0073          IF (USTN(K).GT.50.) GO TO 350                                    00005510
ISN 0075          SDIST=DISTR                                                      00005520
ISN 0076          KK=K                                                             00005530
ISN 0077      350 CONTINUE                                                         00005540
ISN 0078      380 CONTINUE                                                         00005550
ISN 0079          U1(I,J)=USTN(KK)                                                 00005560
ISN 0080          V1(I,J)=VSTN(KK)                                                 00005570
ISN 0081      400 CONTINUE                                                         00005580
            C                                                                      00005590
            C *** ITERATION ***                                                    00005600
            C                                                                      00005610
ISN 0082          DO 420 J=1,JN                                                    00005620
ISN 0083          DO 420 I=1,IN                                                    00005630
ISN 0084          D=0.                                                             00005640
ISN 0085          USUM=0.                                                          00005650
ISN 0086          VSUM=0.                                                          00005660
ISN 0087          KIS=MAX0((I-IRAD), 1)                                            00005670
ISN 0088          KIF=MIN0((I+IRAD),IN)                                            00005680
ISN 0089          KJS=MAX0((J-IRAD), 1)                                            00005690
ISN 0090          KJF=MIN0((J+IRAD),JN)                                            00005700
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      ISN 0091            DO 410 KJ=KJS,KJF
      ISN 0092            RY=(J-KJ)*(J-KJ)                                               00005710
      ISN 0093            DO 410 KI=KIS,KIF                                              00005720
      ISN 0094            RX=(I-KI)*(I-KI)                                               00005730
      ISN 0095            RDIST=RX+RY                                                    00005740
      ISN 0096            IF ((RDIST.GT.RTEST).OR.(RDIST.LE.0.01)) GO TO 410             00005750
      ISN 0098            DISTSQ=1./RDIST                                                00005760
      ISN 0099            USUM=USUM+U1(KI,KJ)*DISTSQ                                     00005770
      ISN 0100            VSUM=VSUM+V1(KI,KJ)*DISTSQ                                     00005780
      ISN 0101            D=D+DISTSQ                                                     00005790
      ISN 0102        410 CONTINUE                                                       00005800
      ISN 0103            UU(I,J)=USUM/D                                                 00005810
      ISN 0104            VV(I,J)=VSUM/D                                                 00005820
      ISN 0105        420 CONTINUE                                                       00005830
                    C                                                                    00005840
                    C *** OBTAIN WIND AT NUMERICAL GRIDS FROM UU AND VV                   00005850
                    C.... LINEAR INTERPOLATION IS USED.                                  00005860
                    C                                                                    00005870
      ISN 0106            CALL     UVINTP     (UU,VV,IN,JN,U1,V1,IM,JM,DX,DY,DELX)       00005880
                    C                                                                    00005890
      ISN 0107            RETURN                                                         00005900
                    C     DEBUG SUBCHK                                                   00005910
                    CC     DEBUG INIT (UU,VV,U1,V1,USTN,VSTN)                            00005920
      ISN 0108            END                                                            00005930
                                                                                         00005940
  *OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

  *OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

  *STATISTICS*     SOURCE STATEMENTS =     107 ,PROGRAM SIZE =     3452

  *STATISTICS*  NO  DIAGNOSTICS GENERATED

  ****** END OF COMPILATION ******                                      97K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                        OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                C                                                                       00005950
  ISN 0002            SUBROUTINE WINDIN ( U,V,W,U1,V1,UU,VV,NEAR,USTN,VSTN,UZF,VZF,WZF  00005960
                     *              ,XSUTM,YSUTM,IUTM,JUTM,Z,DX,DY,DZ                   00005970
                     *              ,IM,JM,KM,IMJM,IJKN,IN,JN,KN,IS,NS)                 00005980
                C                                                                       00005990
                C.... THIS ROUTINE READS IN SURFACE WIND FIELD AND RAMS DATA.           00006000
                C     IT CALLS ROUTINE UVZF AND WWZF TO CONSTRUCT 3-D WIND (U,V,W)      00006010
                C ... KWIND = 1 : INPUT OBJECTIVE ANALYZED WIND U1(IM,JM) & V1(IM,JM);   00006020
                C             2 : INPUT SUBJECTIVE ANALYZED WIND UU(IN,JN) & VV(IN,JN); 00006030
                C             3 : INPUT RAMS DATA AND GENERATE UNIFORM WIND FIELD:      00006040
                C             4 : INPUT RAMS DATA AND GENERATE VARIABLE WIND FIELD.     00006050
                C.... RAMS(I,J) = DATA FROM RAMS STATION. J IS STATION INDEX.           00006060
                C               I=1, WIND SPEED; =2, WIND DIRECTION; =3, 1ST LEVEL TEMP,00006070
                C                =4, 2ND LEVEL TEMP; =5, SO2 CONC.; =6, RADIATION.      00006080
                C                                                                       00006090
  ISN 0003            DIMENSION                                                         00006100
                     *         U(IM,JM,KN), V(IM,JM,KN) ,W(IM,JM,KN)                    00006110
                     *       ,U1(IM,JM),V1(IM,JM),DX(JM),DY(JM),DZ(KM),Z(KM)            00006120
                     *       ,UU(IN,JN),VV(IN,JN),IS(NS),UZF(KM),VZF(KM),WZF(KM)        00006130
                     *       ,NEAR(IN,JN),XSUTM(NS),YSUTM(NS),IUTM(IM),JUTM(JM)         00006140
                     *       ,USTN(NS),VSTN(NS)                                         00006150
                C                                                                       00006160
  ISN 0004            COMMON    /AADATA/                                                00006170
                     *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW           00006180
                     *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC      00006190
                     *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                    00006200
                     *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00006210
                     *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN              00006220
                     *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ       00006230
                C                                                                       00006240
  ISN 0005         800 FORMAT (4I3/,(3(1X,F3.1,F3.0,2F4.1,F3.0,F4.0)))                  00006250
  ISN 0006         870 FORMAT (' *END IN READ WIND DATA* ')                             00006260
  ISN 0007         880 FORMAT (' *ERR IN READ WIND DATA* ')                             00006270
                C                                                                       00006280
                C *** INPUT WIND AAD RAMS DATA ***                                      00006290
                C                                                                       00006300
                C                                                                       00006310
  ISN 0008            GO TO (100,200,300,300), KWIND                                    00006320
                C                                                                       00006330
                C.... KWIND = 1, INPUT PREPROCESSED OBJECTIVE WIND U1,V1                00006340
  ISN 0009         100 READ (KUNITW,END=500,ERR=600) KYR,KMO,KDAY,KHR,U1,V1,RAMS        00006350
  ISN 0010            IF ((KDAY .NE. IDAY) .OR. (KHR .NE. IHR)) GO TO 100               00006360
  ISN 0012            GO TO 400                                                         00006370
                C                                                                       00006380
                C.... KWIND = 2, INPUT SUBJECTIVE ANALYZED WIND UU,VV                    00006390
  ISN 0013         200 CONTINUE                                                         00006400
  ISN 0014         210 READ (KUNITW,END=500,ERR=600) KYR,KMO,KDAY,KHR,UU,VV,RAMS        00006410
  ISN 0015            IF((KDAY .NE. IDAY).OR. (KHR .NE. IHR)) GO TO 210                 00006420
                C ... INTERPOLATE UU(IN,JN) TO U(IM,JM) BY LINEAR INTERPOLATION         00006430
                C          (THIS PORTION OF PROGRAM NEEDS MODIFICATION DEPENDING ON THE 00006440
                C           GRID SYSTEM USED IN THE SUBJECTIVE ANALYSIS OF WIND FIELD)  00006450
  ISN 0017            DELX=IM/(IN-1)                                                    00006460
  ISN 0018            DELY=JM/(JN-1)                                                    00006470
  ISN 0019            IF (DELX.LT.DELY) DELX=DELY                                       00006480
  ISN 0021            CALL UVINTP (UU,VV,IN,JN,U1,V1,IM,JM,DX,DY,DELX)                  00006490
  ISN 0022            GO TO 400                                                         00006500
```

```
                C                                                                       00006510
                C.... KWIND = 3 & 4, INPUT RAMS DATA AND CALL ROUTINE WINDGR TO GENERATE00006520
                C                     SURFACE WIND FIELD AT NUMERICAL GRID              00006530
ISN 0023          300 CONTINUE                                                          00006540
ISN 0024              READ (KUNITW,800,END=500,ERR=600) KYR,KMO,KDAY,KHR,RAMS           00006550
ISN 0025              IF ((KDAY.NE.IDAY).OR.(KHR.NE.IHR)) GO TO 300                     00006560
                C                                                                       00006570
                C     CALL      WINDGR      (U1,V1,UU,VV,NEAR,USTN,VSTN,XSUTM,YSUTM     00006580
                C    &                      ,IUTM,JUTM,DX,DY,IM,JM,IN,JN,NS)            00006590
                C                                                                       00006600
ISN 0027          400 CONTINUE                                                          00006610
                C                                                                       00006620
                C *** OBTAIN AVERAGE WIND SPEED AND STABILITY INDEX ***                  00006630
                C                                                                       00006640
ISN 0028              IF (ITM.GT.0) GO TO 410                                           00006650
ISN 0030              S=0.0                                                             00006660
ISN 0031              ITRAT=0                                                           00006670
ISN 0032          410 SSS=S+3.5                                                         00006680
ISN 0033              TN=0.0                                                            00006690
ISN 0034              UBAR=0.0                                                          00006700
ISN 0035              DO 420 I=1,NS                                                     00006710
ISN 0036              IF (RAMS(1,I).GT.50.) GO TO 420                                   00006720
ISN 0038              TN=TN+1.                                                          00006730
ISN 0039              UBAR=UBAR+RAMS(1,I)                                               00006740
ISN 0040          420 CONTINUE                                                          00006750
ISN 0041              UBAR=UBAR/TN                                                      00006760
ISN 0042              ESKY=RAMS(6,1)                                                    00006770
                C                                                                       00006780
ISN 0043              CALL      STABIT      (UBAR,ESKY,IHR,SSS,ITRAT)                   00006790
ISN 0044              S=SSS-3.5                                                         00006800
                C                                                                       00006810
                C.... STORE SUMMARY OF METEOROLOGICAL PARAMETERS ON ARRAY PARM          00006820
                C     THIS PART OF PROGRAM IS SUBJECTED TO BE MODIFIED ACCORDING        00006830
                C       TO STRUCTURE OF RAMS DATA AND TREATMENT OF MISSING DATA.        00006840
ISN 0045              PARM(1)=UBAR                                                      00006850
ISN 0046              I=0                                                               00006860
ISN 0047          450 I=I+1                                                             00006870
ISN 0048              IF (RAMS(2,I).GT.360.) GO TO 450                                  00006880
ISN 0050              PARM(2)=RAMS(2,I)                                                 00006890
ISN 0051              I=0                                                               00006900
ISN 0052          460 I=I+1                                                             00006910
ISN 0053              IF ((RAMS(3,I).GE.99.).OR.(RAMS(4,I).GE.99.)) GO TO 460           00006920
ISN 0055              PARM(3)=RAMS(3,I)                                                 00006930
ISN 0056              PARM(8)=RAMS(4,I)                                                 00006940
ISN 0057              PARM(4)=S                                                         00006950
ISN 0058              PARM(9)=RAMS(6,1)                                                 00006960
                C                                                                       00006970
ISN 0059              IF((KWIND.EQ.3).OR.(KWIND.EQ.4)) CALL WINDGR  (U1,V1,UU,VV        00006980
                     & ,NEAR,USTN,VSTN,XSUTM,YSUTM,IUTM,JUTM,DX,DY,IM,JM,IN,JN,NS)      00006990
                C                                                                       00007000
                C *** COMPUTE UPPER LAYER U AND V ***                                    00007010
                C                                                                       00007020
ISN 0061              LX=1                                                              00007030
ISN 0062              CALL      UVZF      (U,V,U1,V1,UZF,VZF,WZF,Z,IM,JM,KM,KN,LX)      00007040
                C                                                                       00007050
                C *** COMPUTE VERTICAL WIND COMPONENT ***                                00007060
                C                                                                       00007070
ISN 0063              IF (LWW.GT.0)     CALL      WWZF                                  00007080
```

```
                  & (U,V,W,DX,DY,DZ,IM,JM,KM,KN,LWW,JUNIT)                                  00007090
   ISN 0065           GO TO 700                                                             00007100
                C                                                                           00007110
   ISN 0066         500 WRITE (JUNIT ,870 )                                                 00007120
   ISN 0067           GO TO 700                                                             00007130
   ISN 0068         600 WRITE (JUNIT ,880 )                                                 00007140
                C                                                                           00007150
   ISN 0069         700 CONTINUE                                                            00007160
                C                                                                           00007170
   ISN 0070           RETURN                                                                00007180
                C     DEBUG SUBCHK                                                          00007190
   ISN 0071           END                                                                   00007200
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       70 ,PROGRAM SIZE =      2954

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                    109K BYTES OF CORE NOT USED
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        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C
  ISN 0002               SUBROUTINE WRITES (Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IUTM,JUTM
                        *                  ,IFORM,JUNIT,RATIO,TITLE)
                   C
                   C.... THIS ROUTINE WRITES Q(ISIZE,JSIZE) ON UNIT=JUNIT IN FORM=IFORM.
                   C     IFORM = NO. OF COLUMES TO BE PRINTED ON ONE LINE.
                   C     II    = DUMMY ARRAY FOR TEMPURAL STORAGE
                   C
  ISN 0003               DIMENSION RFMT1(10),RFMT2(10),RFMT3(10),TITLE(10),FMTDS(10)
                        *          ,Q(IXMAX,IYMAX),IUTM(ISIZE),JUTM(JSIZE),II(130)
                   C
  ISN 0004               LOGICAL*1 FMT1(40),FMT2(40),FMT3(40),FM(11)
                   C
  ISN 0005               EQUIVALENCE (FM(1),IFM1),(FM(5),IFM2)
                        * ,(FMT1(1),RFMT1(1)),(FMT2(1),RFMT2(1)),(FMT3(1),RFMT3(1))
                   C
  ISN 0006               DATA RFMT1/'(5X,','5HXU','TM=,','30I4',',   )',5*'    '/
                        *    ,RFMT2/'(5X,','5H  ',' I=,','30I4',',/ )',5*'    '/
                        *    ,RFMT3/'(1X,','2I4,','1X ,','30I4',',   )',5*'    '/
                        *    ,FM/'1','2','3','4','5','6','7','8','9','0',' '/
                   C
  ISN 0007               RETURN
                   C
                   C     ---------------------------------------------------
                   C
                   C *** PRINT HORIZONTAL SURFACE OF VARIABLE Q ***
                   C
  ISN 0008               ENTRY WRITEX (Q,IXMAX,IYMAX,ISIZE,JSIZE,IFORM,JUNIT,RATIO,TITLE)
                   C
  ISN 0009          8000 FORMAT (10A4,F7.2)
  ISN 0010          8040 FORMAT ('    ..... PAGE = ',I5/)
                   C8040 FORMAT('1  ..... PAGE = ',I5,/5X,'IUTM=',30I4,/,5X,'   I=',40I3//)
                   C8050 FORMAT (1X,I4,I4,1X,30I4)
                   C
                   C.... DETERMINE DOMAIN OF ARRAY Q TO BE PRINTED.
  ISN 0011               JEND=JBEG+JSIZE-1
  ISN 0012               IEND=IBEG+ISIZE-1
                   C
                   C.... FIX VARIABLE FORMAT STATEMENTS
  ISN 0013               IF (IFORM .EQ. 0) GO TO 500
  ISN 0015               IF1=IFORM/10
  ISN 0016               IF (IF1.GT.9) IF1=9
  ISN 0018               IF2=IFORM-IF1*10
  ISN 0019               IF (IF2.EQ.0) IF2=10
  ISN 0021               IF (IF1.EQ.0) IF1=11
  ISN 0023               IF3=120/IFORM
  ISN 0024               IF (IF3.GT.9) IF3=9
  ISN 0026               FMT1(13)=FM(IF1)
  ISN 0027               FMT2(13)=FM(IF1)
  ISN 0028               FMT3(13)=FM(IF1)
  ISN 0029               FMT1(14)=FM(IF2)
  ISN 0030               FMT2(14)=FM(IF2)
  ISN 0031               FMT3(14)=FM(IF2)
  ISN 0032               FMT1(16)=FM(IF3)
  ISN 0033               FMT2(16)=FM(IF3)
  ISN 0034               FMT3(16)=FM(IF3)
```

```
                C
                C.... DETERMINE NO. OF PAGES PER ARRAY Q TO BE PRINTED
ISN 0035              IPT=(ISIZE-1)/IFORM+1
                C
                C.... FIX RATIO OF PRINTED VALUE TO ACTUAL VALUE OF Q
ISN 0036              IF (RATIO.NE.0.0) GO TO 100
ISN 0038              RATIO=1000.0
ISN 0039              IF (IFORM .GE. 30) RATIO=100.
ISN 0041          100 CONTINUE
                C
                C.... PRINT THE SPECIFIED TITLE
ISN 0042              WRITE (JUNIT,8000) TITLE,RATIO
                C
                C *** ENTERING PRINTING LOOP ***
ISN 0043              DO 400 IP=1,IPT
ISN 0044              IA=(IP-1)*IFORM+IBEG
ISN 0045              IB=IA+IFORM-1
                C
                C.... FIX INDICES
ISN 0046              DO 200 I=IA,IB
ISN 0047              I1=I-IA+1
ISN 0048              II(I1)=I
ISN 0049              IF ((II(I1).GT.100).AND.(IFORM.GT.30)) II(I1)=II(I1)-100
ISN 0051          200 CONTINUE
                C
                C.... PRINT PAGE NO., INDICES & UTM COORDINATES
ISN 0052              IAX=IA-IBEG+1
ISN 0053              IBX=IAX+IFORM-1
                C     WRITE (JUNIT,8040) IP,(IUTM(I),I=IAX,IBX),(II(I1),I1=IA,IB)
ISN 0054              WRITE (JUNIT,8040) IP
ISN 0055              WRITE (JUNIT,FMT1) (IUTM(I),I=IAX,IBX)
ISN 0056              WRITE (JUNIT,FMT2) (II(I1),I1=IA,IB)
                C
                C.... PRINT ARRAY Q
ISN 0057              DO 320 JJ=1,JSIZE
ISN 0058              J=(JEND+1)-JJ
ISN 0059              JUTMJ=JUTM(JSIZE+1-JJ)
ISN 0060              DO 300 I=IA,IB
ISN 0061              I1=I-IA+1
ISN 0062          300 II(I1)=Q(I,J)*RATIO
                C     WRITE (JUNIT,8050) JUTMJ,J,(II(I1),I1=IA,IB)
ISN 0063              WRITE (JUNIT,FMT3) JUTMJ,J,(II(I1),I1=IA,IB)
ISN 0064          320 CONTINUE
ISN 0065          400 CONTINUE
                C
ISN 0066          500 CONTINUE
                C
ISN 0067              RETURN
                C
                C     -----------------------------------------------------
                C....
                C *** PRINT VERTICAL CROSS SECTION OF VARIABLE A FOR I=IMC AND J=JMC.
                C
ISN 0068              ENTRY WRITEZ (A,Z,RATIO,IM,JM,KM,IMC,JMC,TITLA)
                C....
ISN 0069              DIMENSION A(IM,JM,KM),Z(KM)
                C
ISN 0070         8500 FORMAT (/' ** VERTICAL PROFILE OF ',A4,' AT I=',I3,'; J=',I3,'**')
ISN 0071       8502 FORMAT (/5X,'XUTM=',30I4)                                00008350
ISN 0072       8504 FORMAT (5X,'   I=',30I4/4X,'Z',3X,'K')                   00008360
ISN 0073       8506 FORMAT (/5X,'YUTM=',30I4)                                00008370
ISN 0074       8508 FORMAT (5X,'   J=',30I4/4X,'Z',3X,'K')                   00008380
ISN 0075       8510 FORMAT (1X,2I4,1X,30I4)                                  00008390
              C                                                              00008400
ISN 0076            WRITE (JUNIT,8500) TITLA,IMC,JMC                         00008410
              C                                                              00008420
              C.... PRINT Y-Z CROSS SECTION                                  00008430
ISN 0077            IA=1                                                     00008440
ISN 0078            IB=IM                                                    00008450
ISN 0079            IF (IM.LE.30) GO TO 605                                  00008460
ISN 0081            IA=(IM-30)/2+1                                           00008470
ISN 0082            IB=IA-1+30                                               00008480
ISN 0083        605 CONTINUE                                                 00008490
ISN 0084            WRITE (JUNIT,8502) (IUTM(I),I=IA,IB)                     00008500
ISN 0085            WRITE (JUNIT,8504) (I,I=IA,IB)                           00008510
ISN 0086            J=JMC                                                    00008520
ISN 0087            DO 620 KK=1,KM                                           00008530
ISN 0088            K=KM+1-KK                                                00008540
ISN 0089            KZ=Z(K)                                                  00008550
ISN 0090            DO 610 I=IA,IB                                           00008560
ISN 0091        610 II(I)=A(I,J,K)*RATIO                                     00008570
ISN 0092            WRITE (JUNIT,8510) KZ,K,(II(I),I=IA,IB)                  00008580
ISN 0093        620 CONTINUE                                                 00008590
              C                                                              00008600
              C.... PRINT X-Z CROSS SECTION                                  00008610
ISN 0094            JA=1                                                     00008620
ISN 0095            JB=JM                                                    00008630
ISN 0096            IF (JM.LE.30) GO TO 625                                  00008640
ISN 0098            JA=(JM-30)/2+1                                           00008650
ISN 0099            JB=JA-1+30                                               00008660
ISN 0100        625 CONTINUE                                                 00008670
ISN 0101            WRITE (JUNIT,8506) (JUTM(J),J=JA,JB)                     00008680
ISN 0102            WRITE (JUNIT,8508) (J,J=JA,JB)                           00008690
ISN 0103            I=IMC                                                    00008700
ISN 0104            DO 640 KK=1,KM                                           00008710
ISN 0105            K=KM+1-KK                                                00008720
ISN 0106            KZ=Z(K)                                                  00008730
ISN 0107            DO 630 J=JA,JB                                           00008740
ISN 0108        630 II(J)=A(I,J,K)*RATIO                                     00008750
ISN 0109            WRITE (JUNIT,8510) KZ,K,(II(J),J=JA,JB)                  00008760
ISN 0110        640 CONTINUE                                                 00008770
              C                                                              00008780
ISN 0111            RETURN                                                   00008790
              C     DEBUG SUBCHK                                             00008800
ISN 0112            END                                                      00008810
*OPTIONS IN EFFECT*        NAME= MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      111 ,PROGRAM SIZE =      4028

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                          97K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                         OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C                                                                  00008820
  ISN 0002               SUBROUTINE WWFLUX ( CP1, C,W,WZF,Z,DX,DY,DZ,EK,FK,            00008830
                        *                    RDX,RDY,RDZ,IM,JM,KM,IMJM,IJKM,IJKN)      00008840
                   C                                                                  00008850
                   C.... THIS SUBROUTINE COMPUTES VERTICAL ADVECTION TERM OF           00008860
                   C....  CONCENTRATION EQUATION.                                      00008870
                   C.... SAME NUMERICAL SCHEME AS USED IN SUBROUTINE UVFLUX IS APPLIED 00008880
                   C.... IN THIS SUBROUTINE.                                          00008890
                   C                                                                  00008900
  ISN 0003               DIMENSION                                                    00008910
                        *       CP1(IJKM),C(IJKM),W(IJKN),WZF(KM)                     00008920
                        *       ,DX(IM),DY(JM),DZ(KM),RDX(IM),RDY(JM),RDZ(KM),Z(KM)   00008930
                        *       ,EK(KM),FK(KM)                                        00008940
                   C                                                                  00008950
  ISN 0004               COMMON    /AADATA/                                           00008960
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITS,KUNITP,KUNITS,KUNITW       00008970
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC  00008980
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                                00008990
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00009000
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,DLMIN,DCMIN          00009010
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ   00009020
                   C                                                                  00009030
                   C *** COEFFICIENTS OF FINITE DIFF. FORMULA ***                     00009040
  ISN 0005               LX=1                                                         00009050
  ISN 0006               LY=IM                                                        00009060
  ISN 0007               LZ=IMJM                                                      00009070
  ISN 0008               KN=IJKN/IMJM                                                 00009080
  ISN 0009               KKVMAX=(KN-1)*IMJM                                           00009090
  ISN 0010               DO 20  K= 2, KM                                              00009100
  ISN 0011               FK(K-1)= 1.0/(1.0+RDZ(K))                                    00009110
  ISN 0012            20 EK(K  )= RDZ(K)* FK(K-1)                                     00009120
  ISN 0013               FK(1)= 0.5                                                   00009130
  ISN 0014               FK(KM)=0.5                                                   00009140
                   C                                                                  00009150
                   C *** PROCESS INTERIOR GRID POINT ***                              00009160
  ISN 0015               KK=0                                                         00009170
  ISN 0016               DO 300 K=2,KM1                                               00009180
  ISN 0017               ZK=Z(K)                                                      00009190
  ISN 0018               KK=KK+ IMJM                                                  00009200
  ISN 0019               KKV=KK                                                       00009210
                   C     SAME W FOR K GT KN .....                                     00009220
  ISN 0020               IF ( K .GT. KN) KKV=KKVMAX                                   00009230
  ISN 0022               DTDZ=    DT/DZ(K)                                            00009240
  ISN 0023               JJ=0                                                         00009250
  ISN 0024               DO 200 J= 2,JM1                                              00009260
  ISN 0025               JJ=JJ+ IM                                                    00009270
  ISN 0026               DO 200 I= 2,IM1                                              00009280
  ISN 0027               IJ= I+JJ                                                     00009290
  ISN 0028               IJK = IJ+KK                                                  00009300
  ISN 0029               IJKV=IJ+KKV                                                  00009310
  ISN 0030               AF1= DTDZ*W(IJKV)*WZF(K)                                     00009320
  ISN 0031               A3= AF1*AF1                                                  00009330
  ISN 0032               CIJK= C(IJK)                                                 00009340
  ISN 0033               CIJK1= C(IJK+LZ)                                             00009350
  ISN 0034               CPIJK =CP1(IJK)                                              00009360
  ISN 0035               CPIJK1=CP1(IJK+LZ)                                           00009370
ISN 0036           T1= CIJK+CIJK1                                                    00009380
ISN 0037           T3= CIJK-CIJK1                                                    00009390
ISN 0038           WF= AF1*T1+ A3*T3                                                 00009400
ISN 0039           CCIJK=CPIJK-EK(K)*WF                                              00009410
ISN 0040           CCIJK1= CPIJK1+EK(K)*WF                                           00009420
             C     CHECK FLUX SO THAT FLUX OUT IS LESS THAN MASS IN A CELL ....      00009430
ISN 0041           IF ((CCIJK .GE. 0.0) .AND. (CCIJK1 .GE. 0.0)) GO TO 110           00009440
ISN 0043           IF ( CCIJK .LT. 0.) WF=CPIJK/EK(K)                                00009450
ISN 0045           IF ( CCIJK1 .LT. 0.0) WF=-CPIJK1/EK(K)                            00009460
ISN 0047           CCIJK=CPIJK-EK(K)*WF                                              00009470
ISN 0048           CCIJK1= CPIJK1+EK(K)*WF                                           00009480
ISN 0049       110 CP1(IJK)=CCIJK                                                    00009490
ISN 0050           CP1(IJK+LZ)=CCIJK1                                                00009500
ISN 0051       200 CONTINUE                                                          00009510
ISN 0052       300 CONTINUE                                                          00009520
             C                                                                       00009530
             C *** PROCESS UPPER BOUNDARY GRID POINTS ***                            00009540
             C.... LWTOP IS A CONTROL PARAMETER FOR CONDITON AT TOP BOUNDARY.        00009550
             C.... IF LWTOP=0, VERTICAL ADVECTION IS ASSUMED EQUAL TO ZERO AT        00009560
             C      BOUNDARY                                                         00009570
             C                                                                       00009580
ISN 0053           IF ( LWTOP .EQ. 0) RETURN                                         00009590
             C                                                                       00009600
ISN 0055           KK=KM1*IMJM                                                       00009610
ISN 0056           JJ=-IM                                                            00009620
ISN 0057           DO 500 J=1,JM                                                     00009630
ISN 0058           JJ=JJ+ IM                                                         00009640
ISN 0059           DO 400 I=1,IM                                                     00009650
ISN 0060           IJ= I+JJ                                                          00009660
ISN 0061           IJK = IJ+KK                                                       00009670
ISN 0062           IJKV=IJ+KKVMAX                                                    00009680
ISN 0063           AF1= DTDZ*W(IJKV)*WZF(K)                                          00009690
ISN 0064           IF ( AF1 .LT. 0.0) GO TO 400                                      00009700
ISN 0066           CIJK= C(IJK)                                                      00009710
ISN 0067           CIJK1= C(IJK-LZ)                                                  00009720
ISN 0068           T3= CIJK-CIJK1                                                    00009730
ISN 0069           WF=AF1*T3                                                         00009740
ISN 0070           IF ( CIJK1 .LT. WF) WF= CIJK1                                     00009750
ISN 0072           CP1(IJK)= CIJK+WF                                                 00009760
ISN 0073       400 CONTINUE                                                          00009770
ISN 0074       500 CONTINUE                                                          00009780
             C                                                                       00009790
ISN 0075           RETURN                                                            00009800
             C     DEBUG SUBCHK                                                      00009810
ISN 0076           END                                                               00009820

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       75 ,PROGRAM SIZE =      1738

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                                 OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                        C
  ISN 0002                    SUBROUTINE WWZF (U,V,W,DX,DY,DZ,IM,JM,KM,KN,LWW,JUNIT)
                        C
                        C.... IT CALCULATES VERTICAL WIND W FROM CONTINUITY EQ.
                        C        & SMOOTHES W.
                        C
  ISN 0003                    DIMENSION U(IM,JM,KN),V(IM,JM,KN),W(IM,JM,KN)
  ISN 0004                    DIMENSION DX(IM),DY(JM),DZ(KM)
                        C
  ISN 0005                    IF (LWW.EQ.0) RETURN
                        C
  ISN 0007                    DXM= 0.5/DX(1)
  ISN 0008                    DYM= 0.5/DY(1)
  ISN 0009                    IM1=IM-1
  ISN 0010                    JM1=JM-1
                        C
                        C     LWW=0,NO VERTICAL WIND W;=1,W FROM CONTINUETY EQ;
                        C     =2, W ARE SMOOTHED AGAIN BY 9 POINTS AVERAGE
                        C
  ISN 0011                    DO 100 K=2,KN
  ISN 0012                    DZM= 0.5*(DZ(K)+ DZ(K-1))
  ISN 0013                    DZDY=DZM*DYM
  ISN 0014                    DZDX=DZM*DXM
  ISN 0015                    DO 100 J=2,JM1
  ISN 0016                    DO 100 I=2,IM1
  ISN 0017                    DUDX= DZDX*(U(I-1,J,K-1)-U(I+1,J,K-1))
  ISN 0018                    DVDY= DZDY*(V(I,J-1,K-1)-V(I,J+1,K-1))
  ISN 0019                    W(I,J,K)= W(I,J,K-1)+ DUDX+DVDY
  ISN 0020                100 CONTINUE
                        C
  ISN 0021                    IF (LWW .LT. 2) GO TO 300
  ISN 0023                    DO 220 L=1,2
  ISN 0024                    DO 220 K=2,KN
  ISN 0025                    DO 200 J=1,JM
  ISN 0026                    DO 200 I=1,IM
  ISN 0027                200 W(I,J,1)= W(I,J,K)
                        C
  ISN 0028                    DO 210 J=2,JM1
  ISN 0029                    DO 210 I=2,IM1
  ISN 0030                    WTOT= W(I-1,J,1)+W(I,J,1)+W(I+1,J,1)+W(I-1,J-1,1)+W(I,J-1,1)
                             * +W(I+1,J-1,1)+W(I-1,J+1,1)+W(I,J+1,1)+W(I+1,J+1,1)
  ISN 0031                210 W(I,J,K)=0.111111*WTOT
  ISN 0032                220 CONTINUE
                        C
  ISN 0033                    DO 230 J=1,JM
  ISN 0034                    DO 230 I=1,IM
  ISN 0035                230 W(I,J,1)=0.0
  ISN 0036                300 CONTINUE
                        C
  ISN 0037                    RETURN
                        C     DEBUG SUBCHK
  ISN 0038                    END

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
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*STATISTICS*     SOURCE STATEMENTS =      37 ,PROGRAM SIZE =     1802

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                   109K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                             OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                  00010350
  ISN 0002              SUBROUTINE XYDIFF ( CP1,  C,AKH,AKZ,AKF,RDX,RDY,DXS,DYS,     00010360
                       *                     IM,JM,KM,IMJM,IJKM)                     00010370
                  C.... THIS SUBROUTINE COMPUTES THE HORIZONTAL DIFFUSION TERMS IN    00010380
                  C....  CONCENTRATION EQUATION.                                     00010390
                  C.... THE SECOND ORDER CENTRAL FINITE DIFFERENCE SCHEME IS USED.   00010400
                  C.... THE 3-D VARIABLE A(I,J,K) IS REPRESENTED BY VECTOR A(IJK).   00010410
                  C.... AKH IS HORIZONTAL EDDY EXCHANGE COEFFICIENT.                 00010420
                  C                                                                  00010430
  ISN 0003              DIMENSION                                                    00010440
                       *        CP1(IJKM),C(IJKM),AKH(KM),AKZ(IMJM),AKF(KM)          00010450
                       *      ,RDX(IM),DXS(IM),RDY(JM),DYS(JM),DTKXSI(40),DTKYSI(40) 00010460
                  C                                                                  00010470
                  C     DATA RDXA/1.0/,RDYA/1.0/,RDXB/2.0/,RDYB/2.0/                 00010480
                  C                                                                  00010490
  ISN 0004              COMMON    /AADATA/                                           00010500
                       *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW      00010510
                       *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC 00010520
                       *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                               00010530
                       *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW.LWIND,KWIND,LCRUN,LCHEM 00010540
                       *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,DLMIN,DCMIN         00010550
                       *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,UC,PHIFHZ,HFZ  00010560
                  C                                                                  00010570
  ISN 0005              LX=1                                                         00010580
  ISN 0006              LY=IM                                                        00010590
  ISN 0007              KK=0                                                         00010600
                  C *** COMPUTATION ***                                              00010610
                  C                                                                  00010620
  ISN 0008              DO 300 K= 2,KM                                               00010630
  ISN 0009              DTKH= DT*AKH(K)*AKF(K)                                       00010640
  ISN 0010              DO 10 J=1,JM                                                 00010650
  ISN 0011           10 DTKYSI(J)=DTKH/DYS(J)                                        00010660
  ISN 0012              DO 20 I=1,IM                                                 00010670
  ISN 0013           20 DTKXSI(I)=DTKH/DXS(I)                                        00010680
                  C     DTKXS= DTKH/DXS(1)                                           00010690
                  C     DTKYS= DTKH/DYS(1)                                           00010700
  ISN 0014              KK=KK+ IMJM                                                  00010710
                  C                                                                  00010720
                  C.... INTERIOR REGION, STRAIGHT FORWARD CALCULATION                00010730
                  C *** PROCESS INTERIOR GRID POINTS ***                              00010740
                  C                                                                  00010750
  ISN 0015              JJ=0                                                         00010760
  ISN 0016              DO 200 J= 2,JM1                                              00010770
  ISN 0017              JJ=JJ+ IM                                                    00010780
  ISN 0018              RDYB=1.0+RDY(J)                                              00010790
  ISN 0019              DO 100 I= 2,IM1                                              00010800
  ISN 0020              IJ= I+JJ                                                     00010810
  ISN 0021              IJK = IJ+KK                                                  00010820
  ISN 0022              RDXB=1.0+RDX(I)                                              00010830
  ISN 0023              DXC= C(IJK+LX)-RDXB*C(IJK)+RDX(I)*C(IJK-LX)                  00010840
  ISN 0024              DYC= C(IJK+LY)-RDYB*C(IJK)+RDY(J)*C(IJK-LY)                  00010850
  ISN 0025              CP1(IJK)= CP1(IJK)+(DTKYSI(J)*DYC+DTKXSI(I)*DXC)*AKZ(IJ)     00010860
  ISN 0026          100 CONTINUE                                                     00010870
                  C                                                                  00010880
                  C     EAST-WEST BOUNDRIES,  DIFFUS IN Y ONLY,  DIFF IS ZERO IN X   00010890
                  C *** PROCESS EAST AND WEST BOUNDARY GRID POINTS ***                00010900
                  C                                                                     00010910
   ISN 0027             DO 150 I= 1, IM, IM1                                            00010920
   ISN 0028             IJ= I+JJ                                                        00010930
   ISN 0029             IJK = IJ+KK                                                     00010940
   ISN 0030             DYC= C(IJK+LY)-RDYB*C(IJK)+RDY(J)*C(IJK-LY)                     00010950
   ISN 0031             CP1(IJK)= CP1(IJK)+DTKYSI(J)*DYC*AKZ(IJ)                        00010960
   ISN 0032         150 CONTINUE                                                        00010970
   ISN 0033         200 CONTINUE                                                        00010980
                  C                                                                     00010990
                  C     NORTH-SOUTH BOUNDRY, DIFFUS IN X ONLY, DIFF IS ZERO IN Y        00011000
                  C *** PROCESS SOUTH AND NORTH BOUNDARY GRID POINTS ***                 00011010
                  C                                                                     00011020
   ISN 0034             DO 220 J= 1, JM, JM1                                            00011030
   ISN 0035             JLY=(J-1)*LY                                                    00011040
   ISN 0036             DO 210 I= 2, IM1                                                00011050
   ISN 0037             ILX= (I-1)*LX                                                   00011060
   ISN 0038             IJ= 1+ ILX+JLY                                                  00011070
   ISN 0039             IJK = IJ+KK                                                     00011080
   ISN 0040             DXC= C(IJK+LX)-(1.0+RDX(I))*C(IJK)+RDX(I)*C(IJK-LX)             00011090
   ISN 0041             CP1(IJK)= CP1(IJK)+DTKXSI(I)*DXC*AKZ(IJ)                        00011100
   ISN 0042         210 CONTINUE                                                        00011110
   ISN 0043         220 CONTINUE                                                        00011120
   ISN 0044         300 CONTINUE                                                        00011130
                  C                                                                     00011140
   ISN 0045             RETURN                                                          00011150
                  C     DEBUG SUBCHK                                                    00011160
   ISN 0046             END                                                             00011170

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      45 ,PROGRAM SIZE =      1798

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                   113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                           OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                  C                                                                       00011180
  ISN 0002              SUBROUTINE XYUTMS (IUTM,JUTM,IXBEG,IYBEG,IBEG,JBEG,DX,DY          00011190
                       &                 ,DXA,DYA,IM,JM)                                   00011200
                  C                                                                       00011210
                  C.... THIS ROUTINE COMPUTES UTM COORDINATES FOR ALL NUMERICAL GRIDS.     00011220
                  C.... ENTRY XYUTM1 CONVERT (X,Y) FROM UTM COORDINATES TO NUMERICAL GRID.00011230
                  C                                                                       00011240
  ISN 0003              DIMENSION IUTM(IM),JUTM(JM),DX(IM),DY(JM)                         00011250
                  C                                                                       00011260
  ISN 0004              IM1=IM-1                                                          00011270
  ISN 0005              JM1=JM-1                                                          00011280
  ISN 0006              DXAI=1.0/DXA                                                      00011290
  ISN 0007              DYAI=1.0/DYA                                                      00011300
  ISN 0008              IUTM(1)=IXBEG+IBEG-1                                              00011310
  ISN 0009              JUTM(1)=IYBEG+JBEG-1                                              00011320
  ISN 0010              DO 20 J=1,JM1                                                     00011330
  ISN 0011              JINTVL=DY(J)*DYAI+0.2                                             00011340
  ISN 0012              JUTM(J+1)=JUTM(J)+JINTVL                                          00011350
  ISN 0013           20 CONTINUE                                                          00011360
                  C                                                                       00011370
  ISN 0014              DO 40 I=1,IM1                                                     00011380
  ISN 0015              IINTVL=DX(I)*DXAI+0.2                                             00011390
  ISN 0016              IUTM(I+1)=IUTM(I)+IINTVL                                          00011400
  ISN 0017           40 CONTINUE                                                          00011410
  ISN 0018              IUTMAX=IUTM(IM)+DX(IM)*DXAI+0.2                                   00011420
  ISN 0019              JUTMAX=JUTM(JM)+DY(JM)*DYAI+0.2                                   00011430
                  C                                                                       00011440
  ISN 0020              RETURN                                                            00011450
                  C                                                                       00011460
                  C     ------------------------------------------------------------      00011470
                  C                                                                       00011480
  ISN 0021              ENTRY XYUTM1      (XUTM,YUTM,IDIMAX,XD,YD,IDIM,LWAY)              00011490
                  C                                                                       00011500
                  C.... CHANGE (XUTM,YUTM) FROM UTM TO GRID UNIT (XD,YD) WITH ORIGIN(0,0).00011510
                  C      THE (0,0) IS AT (IUTM(1),JUTM(1)).                               00011520
                  C                                                                       00011530
  ISN 0022              DIMENSION XUTM(IDIMAX),YUTM(IDIMAX),XD(IDIM),YD(IDIM)             00011540
                  C                                                                       00011550
  ISN 0023              DO 200 K=1,IDIM                                                   00011560
  ISN 0024              XI=XUTM(K)                                                        00011570
  ISN 0025              YJ=YUTM(K)                                                        00011580
  ISN 0026              LXI=XI                                                            00011590
  ISN 0027              LYJ=YJ                                                            00011600
  ISN 0028              IF ((LYJ.LT.JUTM(1)).OR.(LYJ.GE.JUTMAX)) GO TO 130                00011610
  ISN 0030              DO 120 J=2,JM                                                     00011620
  ISN 0031              IF (LYJ.GE.JUTM(J)) GO TO 120                                     00011630
                  C                                                                       00011640
                  C.... FIND THE JUTM(J) GREATER THAN LYJ.                                00011650
  ISN 0033              YJJ=J-2                                                           00011660
  ISN 0034              DYB=(YJ-JUTM(J-1))/(DY(J-1)*DYAI)                                 00011670
  ISN 0035              YJ=YJJ+DYB                                                        00011680
  ISN 0036              GO TO 140                                                         00011690
  ISN 0037          120 CONTINUE                                                          00011700
                  C                                                                       00011710
                  C.... YI IS OUTSIDE THE REGION.                                         00011720
  ISN 0038          130 IF (LYJ.LT.JUTM(1)) YJ=(YJ-JUTM(1))/(DY(1)*DYAI)                  00011730
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   ISN 0040          IF (LYJ.GE.JUTMAX)  YJ=(YJ-JUTMAX)/(DY(JM)*DYAI)+JM               00011740
   ISN 0042      140 CONTINUE                                                          00011750
   ISN 0043          IF ((LXI.LT.IUTM(1)).OR.(LXI.GE.IUTMAX)) GO TO 160                00011760
   ISN 0045          DO 150 I=1,IM                                                     00011770
   ISN 0046          IF (LXI.GE.IUTM(I)) GO TO 150                                     00011780
               C                                                                       00011790
               C.... FIND THE IUTM(I) GREATER THAN LXI.                                00011800
   ISN 0048          XII=I-2                                                           00011810
   ISN 0049          DXB=(XI-IUTM(I-1))/(DX(I-1)*DXAI)                                 00011820
   ISN 0050          XI=XII+DXB                                                        00011830
   ISN 0051          GO TO 180                                                         00011840
   ISN 0052      150 CONTINUE                                                          00011850
               C                                                                       00011860
               C.... XI IS OUTSIDE THE REGION.                                         00011870
   ISN 0053      160 IF (LXI.LT.IUTM(1)) XI=(XI-IUTM(1))/(DX(1)*DXAI)                  00011880
   ISN 0055          IF (LXI.GE.IUTMAX)  XI=(XI-IUTMAX)/(DX(IM)*DXAI)+IM               00011890
   ISN 0057      180 CONTINUE                                                          00011900
   ISN 0058          XD(K)=XI                                                          00011910
   ISN 0059          YD(K)=YJ                                                          00011920
   ISN 0060      200 CONTINUE                                                          00011930
               C                                                                       00011940
   ISN 0061          RETURN                                                            00011950
               C     DEBUG SUBCHK                                                      00011960
   ISN 0062          END                                                               00011970

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       61 ,PROGRAM SIZE =      2316

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  113K BYTES OF CORE NOT USED
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LEVEL 21.6 ( MAY 72 )                          OS/360  FORTRAN H

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                           SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                   C                                                                  00011980
 ISN 0002                SUBROUTINE ZZDIFF ( CP1,  C,AKZ,AKF,RDZ,DZS,ZM,EK,FK,        00011990
                        *                     IM,JM,KM,IMJM,IJKM)                     00012000
                   C                                                                  00012010
                   C     IT CALCULATES THE VERTICAL DIFFUSION BY IMPLICIT SECOND CENTRAL  00012020
                   C     SCHEME,FOR VARIABLE GRIDS AND VARIABLE EDDY DIFUSIVITY.      00012030
                   C     CP1=NEW , C=OLD,AKZ=EDDY DIFUSIIVITY, RDZ=GRID RATIO,        00012040
                   C     DZS=GRID SQUARE, EK,FK=TEMPURARY STORAGE, ZM=HEIGHT...       00012050
                   C                                                                  00012060
 ISN 0003                DIMENSION                                                    00012070
                        *         CP1(IJKM),C(IJKM),AKZ(IMJM)                         00012080
                        *        ,RDZ(KM),DZS(KM),ZM(KM),EK(KM),FK(KM),AKF(KM)        00012090
                        *        ,AKKK(20),CKKK(20)                                   00012100
                   C                                                                  00012110
 ISN 0004                COMMON    /AADATA/                                           00012120
                        *   IM1,JM1,KM1,JUNIT,KUNITC,KUNITG,KUNITP,KUNITS,KUNITW      00012130
                        *  ,IYR,IMO,IDAY,IHR,ITM,ITMHR,ITSEC,ITOTHR,ITSTEP,DT,TM,TSEC 00012140
                        *  ,LPRINT,LTSTOP,LTSOUS,LTWIND                               00012150
                        *  ,LWRITE(10),LSOUS(2),LTOP,LWTOP,LPQ,LWW,LWIND,KWIND,LCRUN,LCHEM 00012160
                        *  ,RAMS(6,25),PARM(10),A1(4),AK,HG,HP,HS,OLMIN,DCMIN         00012170
                        *  ,PMAX,PMIN,RIB,ZMAX,ZRPQ,ZRISE,QBTOT,PQBTOT,U0,PHIFHZ,HFZ  00012180
                   C                                                                  00012190
                   C     AKZF IS TO SPECIFY THE VERTICAL SHAPE FUNCTION OF EDDY DIFUSIVITY 00012200
                   C     STABILITY CRITERIA IS (DT*AKZ/DZS) .LT. 1/(4*(1-RATIO)) TO AVOID  00012210
                   C     THE OSCILLATORY MODES.                                       00012220
                   C     LTOP IS TO SPECIFY THE TOP BOUNDRY CONDITIONS,=0, THEN C=0;  00012230
                   C     =1,THEN REFLECTED BOUNDRY.....                               00012240
                   C                                                                  00012250
                   C.... RATIO=0.0,TOTALLY EXPLICIT; =1,TOTALLY IMPLICIT....          00012260
  ISN 0005               RATIO=0.98                                                   00012270
  ISN 0006               RATIOA=(1.0/RATIO-1.0)                                       00012280
  ISN 0007               RATIO2=2.0*RATIO                                             00012290
  ISN 0008               DTT=DT                                                       00012300
  ISN 0009               DO 10 K=1,KM1                                                00012310
  ISN 0010               AKZFK= AKF(K)                                                00012320
  ISN 0011               AKKK(K)= DTT*AKZFK/DZS(K)                                    00012330
  ISN 0012            10 CKKK(K+1) =DTT*AKZFK/DZS(K+1)*RDZ(K+1)                       00012340
  ISN 0013               AKKK(KM)=0.0                                                 00012350
  ISN 0014               CKKK(1)=0.0                                                  00012360
                   C                                                                  00012370
  ISN 0015               LZ=IMJM                                                      00012380
  ISN 0016               JJ=-IM                                                       00012390
  ISN 0017               DO 300 J=1,JM                                                00012400
  ISN 0018               JJ=JJ+IM                                                     00012410
  ISN 0019               DO 200 I=1,IM                                                00012420
  ISN 0020               IJ=I+JJ                                                      00012430
  ISN 0021               AKIJ= AKZ(IJ)*RATIO                                          00012440
  ISN 0022               AKIJ2=2.0*AKIJ                                               00012450
  ISN 0023               AK1= AKIJ2*AKKK(1)                                           00012460
  ISN 0024               BK1= 1.0+AK1                                                 00012470
  ISN 0025               CKKM= AKIJ2*CKKK(KM)                                         00012480
                   C     CK1= 0.0                                                     00012490
  ISN 0026               BKKM= 1.0+CKKM                                               00012500
                   C     AKKM= 0.0                                                    00012510
  ISN 0027               DK1= CP1(IJ)+AK1*(C(IJ+LZ)-C(IJ))*RATIOA                     00012520
  ISN 0028               KMIJ= KM1*IMJM+IJ                                            00012530
ISN 0029          DKKM= CP1(KMIJ)+CKKM*(C(KMIJ-LZ)-C(KMIJ))*RATIOA                00012540
ISN 0030          EK(1)= AK1/BK1                                                   00012550
ISN 0031          FK(1)= DK1/BK1                                                   00012560
ISN 0032          KK=0                                                             00012570
ISN 0033          DO 100 K=2,KM1                                                   00012580
ISN 0034          KK=KK+IMJM                                                       00012590
ISN 0035          IJK= KK+IJ                                                       00012600
ISN 0036          AKK= AKIJ*AKKK(K)                                                00012610
ISN 0037          CKK= AKIJ*CKKK(K)                                                00012620
ISN 0038          BKK= 1.0+AKK+CKK                                                 00012630
ISN 0039          DKG=          AKK*C(IJK+LZ)-(AKK+CKK)*C(IJK)+CKK*C(IJK-LZ)       00012640
ISN 0040          DKK=CP1(IJK)+DKG*RATIOA                                          00012650
ISN 0041          TEMP=1.0/(BKK-CKK*EK(K-1))                                       00012660
ISN 0042          EK(K)= AKK*TEMP                                                  00012670
ISN 0043          FK(K)= (DKK+CKK*FK(K-1))*TEMP                                    00012680
ISN 0044      100 CONTINUE                                                         00012690
             C                                                                     00012700
ISN 0045          EK(KM)=0.0                                                       00012710
ISN 0046          FK(KM)= (DKKM+CKKM*FK(KM1))/(BKKM-CKKM*EK(KM1))                  00012720
ISN 0047          CP1(KMIJ)=FK(KM)                                                 00012730
ISN 0048          IF (LTOP .EQ. 0) CP1(KMIJ)= 0.0                                  00012740
ISN 0050          KK= KM1*IMJM                                                     00012750
ISN 0051          DO 150 L= 1, KM1                                                 00012760
ISN 0052          KK= KK-IMJM                                                      00012770
ISN 0053          IJK= IJ+KK                                                       00012780
ISN 0054          K= KM-L                                                          00012790
ISN 0055          CP1(IJK)= FK(K)+EK(K)*CP1(IJK+LZ)                                00012800
ISN 0056      150 CONTINUE                                                         00012810
ISN 0057      200 CONTINUE                                                         00012820
ISN 0058      300 CONTINUE                                                         00012830
             C                                                                     00012840
ISN 0059          RETURN                                                           00012850
             C    DEBUG SUBCHK                                                     00012860
ISN 0060          END                                                              00012870
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       59 ,PROGRAM SIZE =      1744

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                              113K BYTES OF CORE NOT USED
```

```
LEVEL 21.6 ( MAY 72 )                                  OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF
                 C                                                                     00012880
   ISN 0002            SUBROUTINE     ZZGRID     (ZA,ZB,Z,IMA,IMB,KM)                 00012890
                 C                                                                     00012900
                 C.... IT CONVERTS ZA IN METER UNIT INTO GRID UNIT & STORES IN ZB.     00012910
                 C                                                                     00012920
   ISN 0003            DIMENSION ZA(IMA),ZB(IMB),Z(KM)                                 00012930
                 C                                                                     00012940
   ISN 0004            IMAX=IMA                                                        00012950
   ISN 0005            IF(IMAX .LT. IMB) IMAX=IMB                                      00012960
   ISN 0007            DO 200 I=1,IMAX                                                 00012970
   ISN 0008            IF(ZA(I) .LE. Z(1)) GO TO 110                                   00012980
   ISN 0010            IF(ZA(I) .GE.Z(KM)) GO TO 120                                   00012990
   ISN 0012            DO 100 K=1,KM                                                   00013000
   ISN 0013            IF (ZA(I) .GT. Z(K)) GO TO 100                                  00013010
   ISN 0015            K1=K-1                                                          00013020
   ISN 0016            ZB(I)=K1+(ZA(I)-Z(K1))/(Z(K)-Z(K1)) - 1                         00013030
   ISN 0017            GO TO 200                                                       00013040
   ISN 0018        100 CONTINUE                                                        00013050
   ISN 0019        110 ZB(I)=0.0                                                       00013060
   ISN 0020            GO TO 200                                                       00013070
   ISN 0021        120 ZB(I)=KM-1+(ZA(I)-Z(KM))/(Z(KM)-Z(KM-1))                        00013080
   ISN 0022        200 CONTINUE                                                        00013090
                 C                                                                     00013100
   ISN 0023            RETURN                                                          00013110
                 C     DEBUG SUBCHK                                                    00013120
   ISN 0024            END                                                             00013130

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,DECK,LOAD,NOMAP,NOEDIT,NOID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      23 ,PROGRAM SIZE =      700

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  125K BYTES OF CORE NOT USED

*STATISTICS*    1 DIAGNOSTICS THIS STEP, HIGHEST SEVERITY CODE IS  4
```

```
F128-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP
          DEFAULT OPTION(S) USED -  SIZE=(225280,57344)
IEW0000     INCLUDE SYSLIB(WERCOMX)
IEW0000       ENTRY MAIN


                                                  MODULE MAP

 CONTROL SECTION                       ENTRY

   NAME     ORIGIN  LENGTH               NAME   LOCATION      NAME   LOCATION      NAME   LOCATION      NAME   LOCATION

 WERCOM         00    1238
                                       EXIT          54C    DVCHK         5DE    OVERFL        608    WERTIME        768
                                       WERPARMS      9A8
 IHOECOMH     1238     DE0
                                       IBCOM#       1278    18081971     1278    FDIOCS#      1334    INTSWTCH      2000
 IHOCOMH2     2018     91D
                                       SEQDASD      232A
 IHOEFIOS     2938    1114
                                       FIOCS#       2938    FIOCSBEP     293E
 IHOFIOS2     3A50     5CC
 IHOERRM      4020     624
                                       ERRMON       4020    IHOERRE      4038
 IHOETRCH     4648     2A6
                                       IHOTRCH      4648    ERRTRA       4650
 IHOFCONI     48F0     2FD
                                       FQCONI#      48F0
 IHOFCONO     48F0     402
                                       FQCONO#      48F0
 IHOFCVTH     5088     A07
                                       ADCON#       5088    FCVAOUTP     5162    FCVLOUTP     51F2    FCVZOUTP      534F
                                       FCVIOUTP     56F6    FCVEOUTP     57E8    FCVCOUTP     57E8    INT6SWCH      5A40
 IHOFTEN      5AC0     198
                                       FTEN#        5AC0
 IHOUATBL     5C58     208
 IHOUOPT      5E60     338
 MAIN         6198    CED4
 AACOMP      13070     C5A
 AKZCAL      13CD0     686
 CADJUS      14358     3F8
 CCHECK      14750     17C
 CHEMIC      148D0     218
 CONSIN      14AE8     434
                                       CDTOTP      14EBC
 DIMENS      14F20     870
                                       DIMENI      15648    HHCALC      15724
 DTTEST      15790     74A
 GEOIN       15EE0     876
 OUTAPE      16A58     70E
 POSITV      17168     198
 PRINTS      17300    248C
                                       PRINTA      1967C    PRINTB      196C4    PRINTC      19718
 SHIFTN      19790     22A
```

```
F128-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP
          DEFAULT OPTION(S) USED -  SIZE=(225280,57344)
IEW0000      INCLUDE SYSLIB(WERCOMX)
IEW0000        ENTRY MAIN

                                                MODULE MAP

  CONTROL SECTION                          ENTRY

    NAME     ORIGIN  LENGTH                  NAME    LOCATION      NAME    LOCATION      NAME    LOCATION      NAME    LOCATION

  WERCOM         00    1238
                                           EXIT           54C     DVCHK         5DE     OVERFL        608     WERTIME       768
                                           WERPARMS       9A8

  IHOECOMH     1238     DE0                IBCOM#        1278     19081971     1278     FDIOCS#      1334     INTSWTCH     2000

  IHOCOMH2     2018     91D                SEQDASD       232A

  IHOEFIOS     2938    1114                FIOCS#        2938     FIOCSBEP     293E

  IHOFIOS2     3A50     5CC
  IHOERRM      4020     624                ERRMON        4020     IHOERRE      4038

  IHOETRCH     4648     2A6                IHOTRCH       4648     ERRTRA       4650

  IHOFCONI     48F0     2FD                FQCONI#       48F0

  IHOFCONO     4BF0     4C2                FQCONO#       4BF0

  IHOFCVTH     5088     A07                ADCON#        5088     FCVAOUTP     5162     FCVLOUTP     51F2     FCVZOUTP     534F
                                         ' FCVIOUTP      56F6     FCVEOUTP     57F8     FCVCOUTP     57E8     INT6SWCH     5A40

  IHOFTEN      5AC0     198                FTEN#         5AC0

  IHOUATBL     5C58     208
  IHOUOPT      5F60     338
  MAIN         6198    CFD4
  AACOMP      13070     C5A
  AKZCAL      13CD0     686
  CADJUS      14358     3F8
  CCHECK      14750     17C
  CHEMIC      14800     218
  CONSIN      14AE8     434
                                           CDTOTP       14EBC

  DIMENS      14F20     870                DIMEN1       15648     HHCALC      15724

  DTTEST      15790     74A
  GEOIN       15EE0     876
  OUTAPE      16A58     70F
  POSITV      17168     198
  PRINTS      17300    248C
                                           PRINTA       1967C     PRINTB      196C4     PRINTC      19718
  SHIFTN      19790     32A
```

```
   NAME     ORIGIN  LENGTH            NAME    LOCATION      NAME    LOCATION      NAME    LOCATION      NAME    LOCATION

 SOURCE     19AC0    105E
 SOUSIN     1AB20     3E6
 STABIT     1AF08     55C
 STNCON     1B468     6A0
 TIMEX      1BB08     202
 UVFLUX     1BD10     8B4
 UVINTP     1C5C8     4C4
 UVZF       1CA90     A92
 WINDER     1D528     234
 WINDGR     1D760     D7C
 WINDIN     1E4E0     [illegible]
 WRITES     1F070     FBC
                                  WRITEX     1FFA8     WRITEZ     1FF68
 WWFLUX     20030     6CA
 WWZF       20700     70A
 XYDIFF     20E10     706
 XYUTMS     21518     93C
                                  XYUTM1     2106C
 ZZDIFF     21F28     600
 ZZGRID     224F8     28C
 IHOSLOG *  227B8     104
                                  LOG10      227B8     ALOG10     227B8     IH$ALOG1   227B8     ALOG       227D0
                                  LOG        227D0     IH$ALOG    227D0
 IHOSATN2*  22990     1E8
                                  ATAN2      22990     IH$ATAN2   22990     ATAN       229A4     IH$ATAN    229A4
 IHOSSCN *  22B78     208
                                  COS        22B78     IH$$COS    22B78     SIN        22B9A     IH$$SIN    22B9A
 IHOSEXP *  22D80     180
                                  EXP        22D80     IH$$EXP    22D80
 IHONAMEL*  22F30     C73
                                  FRDNL#     22F30     FWRNL#     2360C
 IHOFRXPR*  23BA8     198
                                  FRXPR#     23BA8
 IHOSSQRT*  23D48     168
                                  SQRT       23D48     IH$SQRT    23D48
 AADATA     23E80     388
 CBLOCK     24238   20000

ENTRY ADDRESS      6198
TOTAL LENGTH      44F38

****MAIN      DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
```

NOTE:

The subprogram listing in the next two pages is an alternate code of subroutine WRITES. This version of subroutine WRITES replaces the previously listed routine when program IBMAQ-2 is to be executed on the EPA Research Triangle Park computer facility. This version of subroutine WRITES was modified from the original subroutine by Ms. Virginia Smiley of EPA.

```
@ELT,SI RAPS*SHIR.WRITES,,,111645032413
      SUBROUTINE WRITES (Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IUTM,JUTM
     *                   ,IFORM,JUNIT,RATIO,TITLE)
C
C.... THIS ROUTINE WRITES Q(ISIZE,JSIZE) ON UNIT=JUNIT IN FORM=IFORM.
C         (VERSION FOR UNIVAC MACHINE.)
C     IFORM = NO. OF COLUMES TO BE PRINTED ON ONE LINE.
C     II    = DUMMY ARRAY FOR TEMPORAL STORAGE
C
      DIMENSION RFMT1(3),RFMT2(3),RFMT3(3),TITLE(10),IFM(11)
     *          ,Q(IXMAX,IYMAX),IUTM(ISIZE),JUTM(JSIZE),II(130)
      DATA RFMT1/'(5X,5H','XUTM=,','30I4) '/
     *    ,RFMT2/'(5X,5H','   I=,','30I4/)'/
     *    ,RFMT3/'(1X,2I','4,1X, ','30I4) '/
     *    ,IFM/061,062,063,064,065,066,067,070,071,060,005/
      RETURN
C
C     ----------------------------------------------
C
C *** PRINT HORIZONTAL SURFACE OF VARIABLE Q ***
C
      ENTRY WRITEX (Q,IXMAX,IYMAX,ISIZE,JSIZE,IFORM,JUNIT,RATIO,TITLE)
C
 8000 FORMAT (10A4,F7.2)
 8040 FORMAT ('   ..... PAGE = ',I5/)
C8040 FORMAT('1  ..... PAGE = ',I5,/5X,'IUTM=',30I4,/,5X,'   I=',40I3//)
C8050 FORMAT (1X,I4,I4,1X,30I4)
C
C.... DETERMINE DOMAIN OF ARRAY Q TO BE PRINTED.
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
C
C.... FIX VARIABLE FORMAT STATEMENTS
      IF (IFORM .EQ. 0) GO TO 500
      IF1=IFORM/10
      IF (IF1.GT.9) IF1=9
      IF2=IFORM-IF1*10
      IF (IF2.EQ.0) IF2=10
      IF (IF1.EQ.0) IF1=11
      IF3=120/IFORM
      IF (IF3.GT.9) IF3=9
      FLD(0,6,RFMT1(3))=IFM(IF1)
      FLD(0,6,RFMT2(3))=IFM(IF1)
      FLD(0,6,RFMT3(3))=IFM(IF1)
      FLD(6,6,RFMT1(3))=IFM(IF2)
      FLD(6,6,RFMT2(3))=IFM(IF2)
      FLD(6,6,RFMT3(3))=IFM(IF2)
      FLD(18,6,RFMT1(3))=IFM(IF3)
      FLD(18,6,RFMT2(3))=IFM(IF3)
      FLD(18,6,RFMT3(3))=IFM(IF3)
C
C.... DETERMINE NO. OF PAGES PER ARRAY Q TO BE PRINTED
      IPT=(ISIZE-1)/IFORM+1
C
C.... FIX RATIO OF PRINTED VALUE TO ACTUAL VALUE OF Q
      IF (RATIO.NE.0.0) GO TO 100
      RATIO=1000.0
      IF (IFORM .GE. 30) RATIO=100.
  100 CONTINUE
C
C.... PRINT THE SPECIFIED TITLE
      WRITE (JUNIT,8000) TITLE,RATIO
C
C *** ENTERING PRINTING LOOP ***
      DO 400 IP=1,IPT
      IA=(IP-1)*IFORM+IBEG
      IB=IA+IFORM-1
C
C.... FIX INDICES
      DO 200 I=IA,IB
      I1=I-IA+1
      II(I1)=I
      IF ((II(I1).GT.100).AND.(IFORM.GT.30)) II(I1)=II(I1)-100
  200 CONTINUE
C
C.... PRINT PAGE NO., INDICES & UTM COORDINATES
      IAX=IA-IBEG+1
      IBX=IAX+IFORM-1
```

```
C     WRITE (JUNIT,8040) IP,(IUTM(I),I=IAX,IBX),(II(I1),I1=IA,IB)
      WRITE (JUNIT,8040) IP
      WRITE (JUNIT,RFMT1)(IUTM(I),I=IAX,IBX)
      WRITE (JUNIT,RFMT2)(II(I1),I1=IA,IB)
C
C.... PRINT ARRAY Q
      DO 320 JJ=1,JSIZE
      J=(JEND+1)-JJ
      JUTMJ=JUTM(JSIZE+1-JJ)
      DO 300 I=IA,IB
      I1=I-IA+1
  300 II(I1)=Q(I,J)*RATIO
C     WRITE (JUNIT,8050) JUTMJ,J,(II(I1),I1=IA,IB)
      WRITE (JUNIT,RFMT3)JUTMJ,J,(II(I1),I1=IA,IB)
  320 CONTINUE
  400 CONTINUE
C
  500 CONTINUE
C
      RETURN
C
C     ------------------------------------------------------------
C....
C *** PRINT VERTICAL CROSS SECTION OF VARIABLE A FOR I=IMC AND J=JMC.
C
      ENTRY WRITEZ (A,Z,RATIO,IM,JM,KM,IMC,JMC,TITLA)
C....
      DIMENSION A(IM,JM,KM),Z(KM)
C
 8500 FORMAT (/' ** VERTICAL PROFILE OF ',A4,' AT I=',I3,': J=',I3,'**')
 8502 FORMAT (/5X,'XUTM=',30I4)
 8504 FORMAT (5X,'   I=',30I4/4X,'Z',3X,'K')
 8506 FORMAT (/5X,'YUTM=',30I4)
 8508 FORMAT (5X,'   J=',30I4/4X,'Z',3X,'K')
 8510 FORMAT (1X,2I4,1X,30I4)
C
      WRITE (JUNIT,8500) TITLA,IMC,JMC
C
C.... PRINT Y-Z CROSS SECTION
      IA=1
      IB=IM
      IF (IM.LE.30) GO TO 605
      IA=(IM-30)/2+1
      IB=IA-1+30
  605 CONTINUE
      WRITE (JUNIT,8502) (IUTM(I),I=IA,IB)
      WRITE (JUNIT,8504) (I,I=IA,IB)
      J=JMC
      DO 620 KK=1,KM
      K=KM+1-KK
      KZ=Z(K)
      DO 610 I=IA,IB
  610 II(I)=A(I,J,K)*RATIO
      WRITE (JUNIT,8510) KZ,K,(II(I),I=IA,IB)
  620 CONTINUE
C
C.... PRINT X-Z CROSS SECTION
      JA=1
      JB=JM
      IF (JM.LE.30) GO TO 625
      JA=(JM-30)/2+1
      JB=JA-1+30
  625 CONTINUE
      WRITE (JUNIT,8506) (JUTM(J),J=JA,JB)
      WRITE (JUNIT,8508) (J,J=JA,JB)
      I=IMC
      DO 640 KK=1,KM
      K=KM+1-KK
      KZ=Z(K)
      DO 630 J=JA,JB
  630 II(J)=A(I,J,K)*RATIO
      WRITE (JUNIT,8510) KZ,K,(II(J),J=JA,JB)
  640 CONTINUE
C
      RETURN
C     DEBUG SUBCHK
      END
```

2. Auxiliary Program Listing

```
MEMBER NAME   TRAPTRL
C.... THIS PROGRAM READS IN EPA NEDS POINT SOURCE DATA AND PRINTS OUT
C     TABLE FOR EACH PLANT.
C     DIMENSION IC(200,140),ISEA(4)
      DIMENSION ISEA(4)
      LOGICAL*1 NAME(40),OWN
      DATA IUNIT/11/,JUNIT/6/
      NPLANT=0
1000  CONTINUE
100   READ (IUNIT,8000,END=1001) I1,I2,I3,ICD
8000  FORMAT (I2,I4,3X,I4,66X,I1)
      IF (ICD.EQ.9) GO TO 1001
      IF (ICD.EQ.6) GO TO 100
      IF (ICD.GE.3) GO TO 2000
      BACKSPACE IUNIT
      GO TO (101,102),ICD
101   CONTINUE
      NPOINT=0
      NPLANT=NPLANT+1
      NSTACK=0
      READ (IUNIT,8001) ISTATE,ICONTY,IPLANT,IUTM,(NAME(K),K=1,40),OWN
8001  FORMAT (I2,I4,3X,I4,4X,I2,2X,40A1,12X,A1)
      WRITE (JUNIT,8510) NPLANT,IUTM,ISTATE,ICONTY,IPLANT
     &      ,(NAME(K),K=1,40),OWN
8510  FORMAT (//I5,',   UTM=',I2,', STATE=',I2,', COUNTY=',I4
     &      ,', PLANT ID=',I4,2X,40A1,2X,':  OWNER=',A1/
     &      5X,'STACK',4X,'UTMX',3X,'UTMY',3X,'ZO',5X,'STAT',3X
     &      ,'SPACE',5X,'TEMP',4X,'T',4X,'FLOW',3X,'ZS',4X,'S-1'
     &      ,2X,'S-2',2X,'S-3',2X,'S-4',3X,'HR',2X,'DAY',3X,'WK')
      ICNT=0
      IOCCA=0
102   CONTINUE
      NPOINT=NPOINT+1
      READ (IUNIT,8002) ISTATE,ICONTY,IPLANT,IPOINT,IHO,IHV,IZO,IPR,IT
     &      ,ITS,IDW,IHT,IPRF,ICD
8002  FORMAT (I2,I4,3X,I5,I2,9X,I5,I5,I4,I5,I4,I7,I5,I5,21X,20X,I1)
      IF (ICD.NE.2) GO TO 1111
      IF (ISTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (ICONTY.NE.ICONTY) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (IPLANT.NE.IPLANT) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
8520  FORMAT (' ** ERROR IN CARD ORDER AT : STATE,COUNTY,PLANT,CD',4I6)
      READ (IUNIT,8000) I1,I2,I3,ICD
      IF (ICD.NE.3) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IERROR=0
103   CONTINUE
      READ (IUNIT,8003) ISTATE,ICONTY,IPLANT,IPOINT,(ISEA(K),K=1,4)
     &      ,IHR,IDAY,IWEEK,IUC,ISPACE,ICD
8003  FORMAT (I2,I4,3X,I4,I2,2X,5I2,I1,I2,7X,I7,60X,I4,4X,I1)
      IF (ICD.EQ.4) GO TO 104
      IF (IERROR.GT.1) GO TO 1000
      WRITE (JUNIT,8521) ISTATE,ICONTY,IPLANT,ICD
      IERROR=1
      GO TO 103
104   CONTINUE
      IF (ISTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (ICONTY.NE.ICONTY) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (IPLANT.NE.IPLANT) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (ISTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (IPOINT.NE.IPOINT) GO TO 1111
```

```
MEMBER NAME  EPAPTRL
      READ (IUNIT,8000) L1,L2,L3,ICD
      IF (ICD.NE.5) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      READ (IUNIT,8000) L1,L2,L3,ICD
      IF (ICD.NE.6) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF ((IPC1.EQ.0).AND.(IPC2.EQ.0)) GO TO 201
      IQCCM=IQCCM+IQP
      IF (IPOINT.LT.IPC2) GO TO 1000
      IQP=IQCCM
      IQCCM=0
      ICCM=0
201   CONTINUE
      NSTACK=NSTACK+1
      XP=IXP
      XP=XP/10.
      YP=IYP
      YP=YP/10.
      DP=IDP
      DP=DP/10.
      SPACE=ISPACE
      SPACE=SPACE/10.
      WRITE (JUNIT,8530) NSTACK,XP,YP,IZP,IQP,SPACE,DP,IT,IFR,IPH
     &     ,(ISEA(K),K=1,4),NHR,NDAY,NWEEK
8530  FORMAT (5X,I5,2F7.1,I5,I9,2F9.1,I5,I8,I5,2X,7I5)
      GO TO 1001
1000  WRITE (JUNIT,8550) ISTATE,ICONTY,IPLANT,ICD
8550  FORMAT (' ***** ERROR EXIT AT : STATE,COUNTY,PLANT,ICD =',4I6)
1001  CONTINUE
      RETURN
      END
```

```
MEMBER NAME  EPART
C.... THIS PROGRAM READS IN EPA NEDS POINT SOURCE DATA AND PRINTS OUT
C       TABLE FOR EACH PLANT.
C        IT ALSO CREATE DATA SET DSN=EPART1.DATA WHICH ELIMINATES
C        STACKS WITH ZERO EMISSION OF SO2.
C       DIMENSION IO(200,140),ISEA(4)
        DIMENSION ISEA(4)
        LOGICAL*1 NAME(40),OWN,KKDATA(80)
        DATA IUNIT/11/,JUNIT/6/,KUNIT/12/
        NPLANT=0
        IOTOT=0
        NUMBER=0
        NOSO2=0
        IFLOW=0
1000    CONTINUE
100     READ (IUNIT,8000,END=1001) I1,I2,I3,ICD
8000    FORMAT (I2,I4,3X,I4,66X,I1)
        IF (ICD.EQ.0) GO TO 1201
        IF (ICD.EQ.6) GO TO 100
        IF (ICD.GE.3) GO TO 3000
        BACKSPACE IUNIT
        GO TO (101,102),ICD
101     CONTINUE
        NPOINT=0
        NPLANT=NPLANT+1
        NSTACK=0
        READ (IUNIT,8001) ISTATE,ICONTY,IPLANT,IUTM,(NAME(K),K=1,40),OWN
8001    FORMAT (I2,I4,3X,I4,4X,I2,2X,40A1,12X,A1)
        WRITE (JUNIT,8510) NPLANT,IUTM,ISTATE,ICONTY,IPLANT
     *           ,(NAME(K),K=1,40),OWN
8510    FORMAT (//I5,',     UTM=',I2,', STATE=',I2,', COUNTY=',I4
     *     ,', PLANT ID=',I4,3X,40A1,3X,':  OWNER=',A1/
     *         5X,'STACK',4X,'UTMX',3X,'UTMY',4X,'ZO',5X,'SO2',3X
     *     ,'SPACE',5X,'DIAM',4X,'T',6X,'FLOW',3X,'Z2',6X,'S-1'
     *     ,2X,'S-2',2X,'S-3',2X,'S-4',4X,'HR',2X,'DAY',3X,'WK')
        ICON=0
        IOCEM=0
102     CONTINUE
        NPOINT=NPOINT+1
        READ (IUNIT,8002) ISTATE,ICONTY,IPLANT,IPOINT,IXP,IYP,IZP,IDD,IT
     *         ,IFS,IDH,IDC1,IDC2,ICD
8002    FORMAT (I2,I4,3X,I4,I2,8X,I4,I5,I4,I3,I4,I3,I4,1X,2I2,23X,I1)
        IF (ICD.NE.2) GO TO 7000
        IF (ISTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
        IF (ICONTY.NE.ICONTY) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
        IF (IPLANT.NE.IPLANT) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
8520    FORMAT ('  *** POSSIBLE ERROR AT : STATE,COUNTY,PLANT,CD',4I6)
        READ (IUNIT,8003) I1,I2,I3,ICD
        IF (ICD.NE.3) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
        IERROR=0
103     CONTINUE
        READ (IUNIT,8003) ISTATE,ICONTY,IPLANT,IPOINT,(ISEA(K),K=1,4)
     *         ,NHR,NDAY,NWEEK,ISO,ISPACE,ICD
8003    FORMAT (I2,I4,3X,I4,I2,2X,5I2,I1,I2,7X,I7,24X,I3,6X,I1)
        IF (ICD.EQ.4) GO TO 104
        IF (IERROR.GT.0) GO TO 7000
        WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
        IERROR=1
        GO TO 103
```

```
MEMBER NAME  EPAPT
104   CONTINUE
      IF (JSTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (JCONTY.NE.ICONTY) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (JPLANT.NE.IPLANT) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (JSTATE.NE.ISTATE) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF (JPOINT.NE.IPOINT) GO TO 3000
      READ (IUNIT,8000) L1,L2,L3,ICD
      IF (ICD.NE.5) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      READ (IUNIT,8000) L1,L2,L3,ICD
      IF (ICD.NE.6) WRITE (JUNIT,8520) ISTATE,ICONTY,IPLANT,ICD
      IF ((IPC1.EQ.0).AND.(IPC2.EQ.0)) GO TO 201
      IQCCM=IQCCM+IQP
      IFLOW=IFLOW+IFR
      IF (IPOINT.LT.IPC2) GO TO 1000
      IQP=IQCCM
      IFR=IFLOW
      IQCCM=0
      IFLOW=0
      ICOM=0
201   CONTINUE
      NSTACK=NSTACK+1
      XP=IXP
      XP=XP/10.
      YP=IYP
      YP=YP/10.
      DP=IDP
      DP=DP/10.
      SPACE=ISPACE
      SPACE=SPACE/10.
      WRITE (JUNIT,8530) NSTACK,XP,YP,IZP,IQP,SPACE,DP,IT,IFR,IPH
     &      ,(ISEA(K),K=1,4),NHP,NDAY,NWEEK
8530  FORMAT (5X,I5,2F7.1,I5,I8,2F9.1,I5,I9,I5,2X,7I5)
      IF (IQP.EQ.0) GO TO 250
      NUMBER=NUMBER+1
      WRITE (KUNIT,8700) NPLANT,NSTACK,ISTATE,ICONTY,IPLANT,IUTM
     &      ,IXP,IYP,IZP,IQP,ISPACE,IDP,IT,IFR,IPH,(ISEA(K),K=1,4)
     &      ,NHP,NDAY,NWEEK
8700  FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
      IQTOT=IQTOT+IQP
      GO TO 1000
250   CONTINUE
      NOSO2=NOSO2+1
      GO TO 1000
3000  WRITE (JUNIT,8550) ISTATE,ICONTY,IPLANT,ICD
8550  FORMAT (' ***** ERROR EXIT AT : STATE,COUNTY,PLANT,ICD =',4I6)
1001  CONTINUE
      REWIND KUNIT
      QTOT=IQTOT
      WRITE (JUNIT,8710) NUMBER,QTOT,NOSO2
8710  FORMAT (1H1,' *** NUMBER OF POINT SOURCE =',I5,' ***'/
     &      ' *** TOTAL SO2 EMISSION =',F14.7,' (TONS/YR) ***'//
     &      ' *** NO. OF POINT SOURCE WITHOUT SO2 EMMISION =',I4,' ***'/
     &      /// ' *** REDUCED POINT SOURCE DATA ***'/
     &      '         ..... DSN=EPAPT1.DATA')
      DO 300 N=1,NUMBER
      READ (KUNIT,8750) (KKDATA(K),K=1,80)
      WRITE (JUNIT,8760) N,(KKDATA(K),K=1,80)
8750  FORMAT (80A1)
```

```
MEMBER NAME  CHART
8763  FORMAT (I5,',   ',' A1)                                       00001170
300   CONTINUE                                                      00001180
      RETURN                                                        00001190
      END                                                           00001200
```

```
MEMBER NAME  EPACLKTB
C.... THIS PROGRAM IS PROVIDED BY EPA. IT COPY DSN=EPACLKTB.DATA TO      00000004
C        DSN=EPACLK.DATA FOR DIRECT ACCESS READ.                        00000005
C.... THE DATA SET IS CLARK'S TABLE. IT NEEDS TO COMPUTE UTM COORDINATES00000006
C       OF A POINT IN ZONE II AS EXTENSION OF ZONE JJ.                  00000007
      DIMENSION B1(8,8)                                                 00000010
      REAL*8 B1                                                         00000020
      DATA IUNIT/11/,JUNIT/6/                                           00000021
      DEFINE FILE 3(61,768,L,IJK)                                       00000030
      DO 10 JBLOCK=1,61                                                 00000040
      READ(IUNIT,1000) ((B1(I,J),J=1,8),I=1,8)                          00000050
      WRITE(3'JBLOCK) B1                                                00000060
   10 CONTINUE                                                          00000070
      IJK=1                                                             00000080
      DO 20 JBLOCK=1,61                                                 00000090
      READ(3'JBLOCK) B1                                                 00000100
      WRITE(JUNIT,2000) ((B1(I,J),J=1,8),I=1,8)                         00000110
   20 CONTINUE                                                          00000120
 1000 FORMAT(1X,F11.3,2F10.3,F8.3,2F6.3,2F5.3)                          00000130
 2000 FORMAT(1X,F12.3,2F11.3,F9.3,2F7.3,2F6.3)                          00000140
      STOP                                                              00000150
      END                                                               00000160
```

```
MEMBER NAME  EPAPT1
C.... THIS PROGRAM COMPUTES POINT SOURCE LOCATION ACCORDING
C        TO UTM ZONE 15.
C.... OUTPUT IS DSN=EPAPT2.DATA WITH ALL SOURCES LOCATION AS IN
C         UTM ZONE 15.
C       DIMENSION IC(200,140),ISEA(4)
        DIMENSION ISEA(4)
        REAL*8 XP,YP,X,Y
        LOGICAL*1 NAME(40),CWN,KKDATA(40)
        DATA IUNIT/11/,JUNIT/6/,KUNIT/12/
        IQTOT=0
        NUMBER=0
        WRITE (JUNIT,8010)
8010    FORMAT (2X,'POINT  PLANT STACK UTM',5X,'UTMX'
     &          ,6X,'UTMY',6X,'X-15',6X,'Y-15',3X,'ZP',4X,'QP'//)
1000    CONTINUE
        READ (IUNIT,9000,END=1001) NPLANT,NSTACK,ISTATE,ICONTY,IPLANT
     &        ,IUTM,XP,YP,IZP,IQP,ISPACE,IDP,IT,IFR,IDH,(ISEA(K),K=1,4)
     &        ,NHR,NDAY,NWEEK
C8000   FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
9000    FORMAT (I4,2I2,2I4,I2,F4.1,F5.1,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
        IQTOT=IQTOT+IQP
        NUMBER=NUMBER+1
        IF (IUTM.EQ.15) GO TO 110
        IF (IUTM.EQ.0) GO TO 100
        IF (XP.EQ.0.) GO TO 100
        IF (YP.EQ.0.) GO TO 100
        X=XP*1000.
        Y=YP*1000.
        CALL GTGP (J,Y,X,C)
        X=X/1000.
        Y=Y/1000.
        GO TO 120
100     CONTINUE
        X=0.
        Y=0.
        GO TO 120
110     CONTINUE
        X=XP
        Y=YP
120     CONTINUE
        WRITE (JUNIT,8720) NUMBER,NPLANT,NSTACK,IUTM,XP,YP,X,Y,IZP,IQP
8720    FORMAT (2X,I5,'.',2I6,I4,4F10.3,I5,I8)
8510    FORMAT (//I5,',   UTM=',I2,',  STATE=',I2,',  COUNTY=',I4
     &          ,',  PLANT ID=',I4,4X,40A1,3X,':  OWNER=',A1/
     &          5X,'STACK',3X,'UTMX',7X,'UTMY',3X,'ZP',5X,'SO2',3X
     &          ,'SPACE',5X,'DIA',4X,'T',4X,'FLOW',3X,'ZR',4X,'S-1'
     &          ,2X,'S-2',2X,'S-3',2X,'S-4',3X,'HR',2X,'DAY',3X,'WK')
         IXP=X*10.+0.5
         IYP=Y*10.+0.5
         WRITE (KUNIT,8700) NPLANT,NSTACK,ISTATE,ICONTY,IPLANT,IUTM
     &        ,IXP,IYP,IZP,IQP,ISPACE,IDP,IT,IFR,IDH,(ISEA(K),K=1,4)
     &        ,NHR,NDAY,NWEEK
8700    FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
        GO TO 1000
1001    CONTINUE
        QTOT=IQTOT
        WRITE (JUNIT,8710) NUMBER,QTOT
8710    FORMAT (/////' *** NUMBER OF POINT SOURCE =',I5,'  ***'/
MEMBER NAME  EPART1
     5      '  *** TOTAL SO2 EMISSION =',E14.7,' (TONS/YR) ***')
300   CONTINUE
      WRITE (JUNIT,8750)
8750  FORMAT ('1  *** DATA SET DSN=EPART2,DATA ***' //)
      REWIND KUNIT
400   READ (KUNIT,8730,END=410) (KKDATA(K),K=1,80)
      WRITE (JUNIT,8740) (KKDATA(K),K=1,80)
      GO TO 400
410   CONTINUE
8730  FORMAT (80A1)
8740  FORMAT (5X,80A1)
      RETURN
      END
      SUBROUTINE GTCH(NARCS,CN,CE,IW)
C.... THIS SUBROUTINE IS PROVIDED BY EPA. IT COMPUTES UTM
C       COORDINATES FROM ONE ZONE TO ANOTHER.
      DIMENSION B1(8,8),NB(61)
      REAL*8 B1,A1,RN,RE,CNP,CEP,A,B,C,D,CN,CE,V1
      DEFINE FILE 3(61,758,L,IJK)
      DATA NB/20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,
     1        39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,
     2        58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,
     3        77,78,79,80/
       A1 = CN/100000.0
       IN = A1 + .5
       RN = IN * 100000
       A1 = CE/100000.0
       IE = A1 + .5
       RE = IE * 100000
       CNP = (CN-RN)*.00001
       CEP = (CE-RE)*.00001
       DO 40 I=1,61
       IF (NB(I).EQ.IN) GO TO 50
   40 CONTINUE
   50 IBLOCK = I
       READ(3'IBLOCK) B1
       IF (IW.EQ.1) GO TO 60
       IF (IW.EQ.0) GO TO 70
   60 IE = 10 - IE
       GO TO 80
   70 V1 = -1.0
       B1(IE,2) = B1(IE,2) * V1
       B1(IE,4) = B1(IE,4) * V1
       B1(IE,6) = B1(IE,6) * V1
       B1(IE,8) = B1(IE,8) * V1
   80 A =(B1(IE,5)+((CNP*B1(IE,7))-(CEP*B1(IE,8))))
       B =(B1(IE,6)+((CNP*B1(IE,8))+(CEP*B1(IE,7))))
       C =(B1(IE,3)+((CNP*A)-(CEP*B)))
       D =(B1(IE,4)+((CNP*B)+(CEP*A)))
       CN =(B1(IE,1)+((CNP*C)-(CEP*D)))
       CE =(500000.0+B1(IE,2)+((CNP*D)+(CEP*C)))
       RETURN
       END
```

```
MEMBER NAME  PRART2
C.... THIS PROGRAM COMPUTES PLUME RISES FOR ALL POINT SOURCES.          00000010
C        IT USES FIVE FORMULAE AS LISTED IN PRINT OUT.                  00000020
      DIMENSION ISEA(4)                                                 00000030
      DIMENSION ZR1(270),ZR2(270),ZR3(270),ZR4(270),ZR5(270)            00000040
       DIMENSION A(3),U1(3),U2(3),U3(3),U4(3),U5(3)                     00000050
       DIMENSION PR1(3),PR2(3),PR3(3),PR4(3),PR5(3)                     00000060
      DATA CP/.24/,RHO/1.29/                                            00000070
      DATA A/0.,0.5,1.0/                                                00000080
      DATA IUNIT/11/,JUNIT/6/                                           00000090
C                                                                       00000100
C     **CALCULATES PLUME RISE NOT ACCOUNTING FOR WIND SPEED**           00000110
C                                                                       00000120
      WRITE (JUNIT,8500)                                                00000130
8500  FORMAT ('1 *** PLUME RISE NORMALIZED BY WIND SPEED ***'//         00000140
     &      ' ZR1=(-0.029*VS*D+5.35*QH**0.5)/U....CARSON & MOSES'/      00000150
     &      ' ZR2=133.*(FF/U**3.)**0.27 ......CSANADY MODIFIED'/        00000160
     &      ' ZR3=0.047*QH**0.58/(U**0.70) ...CONCAWE--1'/              00000170
     &      ' ZR4=0.175*QH**0.50/(U**0.75) ...CONCAWE--2'/              00000180
     &      ' ZR5=0.414*QH**.444/(U**.694) ...CONCAWE--3'///            00000190
     &       '  N  ID  S    XP     YP     ZP        Q    D       TS'     00000200
     &      ,'   FLOW    PH    ZR1    ZR2    ZR3    ZR4    ZR5'//)      00000210
       N=0                                                              00000220
       CPRHO=CP*RHO*1000.                                               00000230
       PI4=4./3.14159                                                   00000240
1000  CONTINUE                                                          00000250
      READ (IUNIT,8000,END=1001) NPLANT,NSTACK,ISTATE,ICONTY,IPLANT     00000260
     &      ,IUTM,XP,YP,ZP,IQP,ISPACE,DP,TS,FR,PH,                      00000270
     &      (ISEA(K),K=1,4),IHR,NDAY,NWEEK                              00000280
8000  FORMAT (I4,2I2,2I4,I2,F4.1,F5.1,F4.0,I7,I3,F3.1,F4.0              00000290
     &      ,F7.0,F4.0,6I2,I1,I2)                                       00000300
       N=N+1                                                            00000310
       ZP=ZP*0.3048                                                     00000320
       DP=DP*0.3048                                                     00000330
       IF (TS.EQ.0.) GO TO 100                                          00000340
       TS=(TS-32.)*5./9.                                                00000350
100    CONTINUE                                                         00000360
       FR=FR*0.028317/60.                                               00000370
       PH=PH*0.3048                                                     00000380
       IF (TS.LE.0.) GO TO 110                                          00000390
       IF (FR.LE.0.) GO TO 110                                          00000400
       VSD=FR*PI4/DP                                                    00000410
       QH=FR*CPRHO*TS                                                   00000420
       FF=9.81*TS*FR/273.                                               00000430
       ZR1(N)=(-0.029*VSD+5.35*(QH*0.001)**0.5)                         00000440
       ZR2(N)=133.*FF**0.27                                             00000450
       ZR3(N)=0.047*QH**0.58                                            00000460
       ZR4(N)=0.175*QH**0.50                                            00000470
       ZR5(N)=0.414*QH**0.444                                           00000480
       GO TO 120                                                        00000490
  110 CONTINUE                                                          00000500
       ZR1(N)=0.                                                        00000510
       ZR2(N)=0.                                                        00000520
       ZR3(N)=0.                                                        00000530
       ZR4(N)=0.                                                        00000540
       ZR5(N)=0.                                                        00000550
120    CONTINUE                                                         00000560
       WRITE (JUNIT,8510) N,NPLANT,NSTACK,XP,YP,ZP,IQP,DP,TS,FR,PH,     00000570
     &        ZR1(N),ZR2(N),ZR3(N),ZR4(N),ZR5(N)                        00000580
```

```
MEMBER NAME  EPART2
9510  FORMAT (1X,I3,I4,I3,F6.1,F7.1,F6.1,I9,F5.1,F7.1,F8.1,F5.1,
     &        5F7.1)
       GO TO 1000
1001   CONTINUE
        LM=N
C      **CALCULATES PLUME RISE FOR THREE VALUES OF WIND SPEED AND FOR
C         FOUR VALUES OF THE PARAMETER A**
C
      U=-2.
      DO 400 I=1,3
      U=U+3.
      WRITE (JUNIT,8600) U,(A(K),K=1,3)
8600  FORMAT ('1 *** PLUME RISE COMPUTED BY VARIOUS FORMULAE FOR U ='
     &      ,F3.1,' M/SEC ***'//6X,3(3X,13('-'),' A=',F5.2,1X,13('-'))/
     &   3X,'N',2X,3(6X,'ZR1',4X,'ZR2',4X,'ZR3',4X,'ZR4',4X,'ZR5',1X)/)
      DO 200 K=1,3
      UU=U+A(K)*EXP(-U)
      U1(K)=UU
      U2(K)=UU**(3.0*0.27)
      U3(K)=UU**0.70
      U4(K)=UU**0.75
      U5(K)=UU**0.694
200   CONTINUE
      DO 500 J=1,LM
      DO 300 K=1,3
      PR1(K)=ZR1(J)/U1(K)
      PR2(K)=ZR2(J)/U2(K)
      PR3(K)=ZR3(J)/U3(K)
      PR4(K)=ZR4(J)/U4(K)
      PR5(K)=ZR5(J)/U5(K)
300   CONTINUE
      WRITE (JUNIT,8610) J,(PR1(K),PR2(K),PR3(K),PR4(K),PR5(K),K=1,3)
  500 CONTINUE
  400 CONTINUE
8610  FORMAT (1X,I3,' *',3(3X,5F7.1))
      STOP
      END
```

```
MEMBER NAME  COADT2
C.... THIS PROGRAM MAPS POINT SOURCE EMISSION TO ONE SQ. KM. GRID.
      DIMENSION Q(200,140),ISEA(4)
      INTEGER*2 NPS(200,140),NPT
      DATA IUNIT/11/,JUNIT/6/,KUNIT/12/
      DATA Q/28000*0.0/,NPS/28000*0/
      QTOT=0
      NUMBER=0
      IXMAX=200
      IYMAX=140
      IXBEG=640
      IYBEG=4190
      XBEG=IXBEG
      YBEG=IYBEG
      XEND=XBEG+IXMAX
      YEND=YBEG+IYMAX
      ICXBEG=725
      ICYBEG=4252
      ICXEND=765
      ICYEND=4311
      CXBEG=ICXBEG
      CYBEG=ICYBEG
      CXEND=ICXEND
      CYEND=ICYEND
      WRITE (JUNIT,8010)
8010  FORMAT ('1   *** POINT SOURCE OUTSIDE AREA SOURCE MAP ***'
C    &       //'   ...... Q IN GRAM/SEC.  ...........'
     &        //2X,'POINT  PLANT STACK UTM',5X,'UTMX'
     &        ,6X,'UTMY',3X,'ZP',6X,'Q'//)
1000  CONTINUE
      READ (IUNIT,8000,END=1001) NPLANT,NSTACK,ISTATE,ICONTY,IPLANT
     &     ,IUTM,XP,YP,IZP,QP,ISPACE,IDP,IT,IFR,IDH,(ISEA(K),K=1,4)
     &     ,NHR,NDAY,NWEEK
C8000 FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
8000  FORMAT (I4,2I2,2I4,I2,F4.1,F5.1,I4,F7.2,2I3,I4,I7,I4,5I2,I1,I2)
C     QP=QP*0.02876664
C ....  .02876664 IS CONVERSION FACTOR FROM TONS/YEAR TO GRAM/SEC.
      NUMBER=NUMBER+1
      QTOT=QTOT+QP
      IF ((XP.GT.XEND).OR.(XP.LT.XBEG)) GO TO 100
      IF ((YP.GT.YEND).OR.(YP.LT.YBEG)) GO TO 100
      IXP=XP
      IYP=YP
      KX=IXP-IXBEG+1
      KY=IYP-IYBEG+1
      Q(KX,KY)=Q(KX,KY)+QP
      NPS(KX,KY)=NPS(KX,KY)+1
      GO TO 1000
100   CONTINUE
      WRITE (JUNIT,8720) NUMBER,NPLANT,NSTACK,IUTM,XP,YP,IZP,QP
8720  FORMAT (2X,I5,'.',2I6,I4,2F10.3,I5,F9.1)
      GO TO 1000
8510  FORMAT (//I5,',   UTM=',I2,', STATE=',I2,', COUNTY=',I4
     &       ,', PLANT ID=',I4,8X,40A1,3X,':  OWNER=',A1/
     &       5X,'STACK',3X,'UTMX',3X,'UTMY',3X,'ZP',6X,'SO2',3X
     &       ,'SPACE',5X,'DIA',4X,'T',4X,'FLOW',3X,'ZR',4X,'S-1'
     &       ,2X,'S-2',2X,'S-3',2X,'S-4',3X,'HR',2X,'DAY',3X,'WK')
9700  FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2)
1001  CONTINUE
```

```
MEMBER NAME  EPAPT3
      WRITE (JUNIT,8520)
8520  FORMAT (///'  *** POINT SOURCE EMISSION PER EACH ONE SQ. KM.'
     &        ,' GRID ***'//6X,'I',4X,'J UTMX  UTMY',7X,'Q',3X,'N'//)
      NPT=0
      DO 200 I=1,IXMAX
      DO 200 J=1,IYMAX
      IF (Q(I,J).LE.0.) GO TO 200
      IUTMX=I+IXBEG-1
      IUTMY=J+IYBEG-1
      NPT=NPT+NPS(I,J)
      WRITE (JUNIT,8530) I,J,IUTMX,IUTMY,Q(I,J),NPS(I,J)
8530  FORMAT (2X,3I5,I6,F10.1,I3)
200   CONTINUE
      WRITE (JUNIT,8540) NPT
8540  FORMAT (///' *** NUMBER OF POINT SOURCE IN AREA SOURCE MAP ='
     &        ,I5,' ***'//)
8710  FORMAT (/////' *** NUMBER OF POINT SOURCE =',I5,' ***'/
     &      '  *** TOTAL SO2 EMISSION =',F14.7,' (TONS/YR) ***')
300   CONTINUE
      CALL EPAMAP (Q,QTOT,NPS)
      RETURN
      END
```

```
MEMBER NAME  EPAPT4
      SUBROUTINE EPAMAP (Q,QTOT,NPS)
C.... THIS READS IN EPA NEDS AREA SOURCES DATA (TON/YEAR)
C.... IN UNIFORM 1-KM GRID AND CHOOSE A SUB-AREA FOR ANALYSIS.
C.... IXBEG,IYBEG=ORIGIN OF THE GRIDS IN UTM,IXMAX,IYMAX=AREA SIZE IN KM
C.... QA,Q(200,140)=AREA SOURCE STRENGTH.
C.... IBEG,JBEG=ORIGIN OF THE SUB-AREA
C.... ISIZE,JSIZE= SIZE OF THE SUB-AREA.
C....
      DIMENSION Q(200,140), TQ(200),IXUTM(200),JYUTM(140),II(200)
     *          ,IA(200),JA(140)
      INTEGER*2 NPS(200,140),NPT
C     DATA Q/28000*0.0/,IUNIT/5/, JUNIT/6/,KUNIT/11/,IFORM/40/
      DATA IUNIT/5/,JUNIT/6/,KUNIT/11/,IFORM/20/
     *    ,IXBEG/640/,IYBEG/4190/,IXMAX/200/,IYMAX/140/
     *    ,IBEG/86/,JBEG/63/,ISIZE/40/,JSIZE/60/,DXA/1./,DYA/1./
      DIMENSION QC(30,40),IR(10),JR(10),DXR(10),DYR(10)
      DATA IRM/3/,JRM/3/,IR/5,20,5,7*0/,JR/10,20,10,7*0/,IM/30/,JM/40/
     *    ,DXR/2.0,1.0,2.0,7*2.0/,DYR/2.0,1.0,2.0,7*2.0/
C....
      IA(1)=IBEG
      JA(1)=JBEG
C.... READ IN Q(200,140) AND QTOT.
C     REWIND KUNIT
C     DO 100 J=1,IYMAX
C     READ (KUNIT,8060) (Q(I,J),I=1,IXMAX)
 8060 FORMAT (10E7.5,10X)
  100 CONTINUE
C     READ (KUNIT,8070) QTOT
 8070 FORMAT (E12.6)
C....
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
      ITOT=ISIZE*JSIZE
C.... SUM THE TOTAL SOURCE QTOT FOR SUB-AREA.
      SQTOT=0.0
      NPT=0
      DO 200 J=JBEG,JEND
      DO 200 I=IBEG,IEND
      NPT=NPT+NPS(I,J)
  200 SQTOT=SQTOT+Q(I,J)
      RQTOT=SQTOT/QTOT
      WRITE (JUNIT,8030) ITOT,SQTOT,QTOT,RQTOT
 8030 FORMAT (' *** NUMBER OF AREA SOURCES = ',I10,' ***'/
     &        ' *** TOTAL SOURCE EMISSION & RATIO= ',3E13.5, ' ***')
      WRITE (JUNIT,8040) NPT
 8040 FORMAT (/' *** NUMBER OF POINT SOURCES IN COMPUTATIONAL GRID ='
     &       ,I4,' ***'//)
C....
      DO 300 J=1,JSIZE
  300 JYUTM(J)=IYBEG+JBEG+J-2
      DO 310 I=1,ISIZE
  310 IXUTM(I)=IXBEG+IBEG+I-2
C     CALL WRITEQ(Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM,IFORM
C    *          ,JUNIT,II)
      WRITE (JUNIT,8510)
      DO 400 J=1,JSIZE
      DO 400 I=1,ISIZE
      Q(I,J)=Q(I,J)*0.12976664
```

```
MEMBER NAME  EPART4
      IF ((Q(I,J).GT.0.).AND.(Q(I,J).LT.1.)) Q(I,J)=1.0
C   .... 0.02976664 CONVERT TON/YR TO GRAM/SEC.
  400 CONTINUE
      CALL GRIDCN(Q,IXMAX,IYMAX,IA,JA,DXA,DYA,QQ,IM,JM,IB,JB,DXB,DYB,
     *            IBM,JBM,IXUTM,JYUTM,II)
      CALL WRITEQ(QQ,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,II)
C     CALL WRITEQ (Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM
C    &            ,IFORM,JUNIT,II)
      WRITE (JUNIT,8520)
8510  FORMAT (///' *** ABOVE PRINTING Q IN TONS/YEAR ***')
8520  FORMAT (///' *** ABOVE PRINTING Q IN GRAM/SEC. ***')
      RETURN
      END
      SUBROUTINE WRITEQ (Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM
     *                 ,IFORM,JUNIT,II)
C.... THIS WRITES Q(ISIZE,JSIZE) ON UNIT=JUNIT IN FORM=IFORM.
C.... IFORM=NO. OF COLUMES TO BE PRINTED ON ONE LINE.
C....
      DIMENSION RFMT1(10),RFMT2(10),RFMT3(10)
      LOGICAL*1 FMT1(40),FMT2(40),FMT3(40),FM(8)
      EQUIVALENCE (FM(1),IFM1),(FM(5),IFM2)
     * ,(FMT1(1),RFMT1(1)),(FMT2(1),RFMT2(1)),(FMT3(1),RFMT3(1))
      DATA RFMT1/'(5X,','5HXU','TM=,','40I3',',   )',5*'    '/
     *    ,RFMT2/'(5X,','5H  ',' I=,','40I3',',/ )',5*'    '/
     *    ,RFMT3/'(1X,','2I4,','1X ,','40I3',',   )',5*'    '/
      DIMENSION Q(IXMAX,IYMAX),IXUTM(ISIZE),JYUTM(JSIZE) ,II(ISIZE)
     *          ,IQ(200)
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
      IF (IFORM .EQ. 0) GO TO 500
      IFM1=120/IFORM+240
      IFM2=IFORM/10+240
      FMT1(16)=FM(4)
      FMT2(16)=FM(4)
      FMT3(16)=FM(4)
      FMT1(13)=FM(8)
      FMT2(13)=FM(8)
      FMT3(13)=FM(8)
      IPT=(ISIZE-1)/IFORM+1
      RATIO=1000.0
      IF (IFORM .GE. 30) RATIO=100.
      IF (IFORM .GE. 40) RATIO=10.0
C     RATIO=10.0
      RATIO=1.0
      DO 310 IP=1,IPT
      IA=(IP-1)*IFORM+IBEG
      IB=IA+IFORM-1
      DO 320 I=IA,IB
      II(I)=I
      IF((II(I).GT. 100) .AND.(IFORM.GT. 30))II(I)=II(I)-100
  320 CONTINUE
      IAX=IA-IBEG+1
      IBX=IAX+IFORM-1
C     WRITE (JUNIT,8040) IP,(IXUTM(I),I=IAX,IBX),(II(I),I=IA,IB)
C8040 FORMAT('1  ***** PAGE = ',I5,/5X,'IUTM=',40I3,/,5X,'   I=',40I3//)
      WRITE (JUNIT,8040) IP
 8040 FORMAT ('1  ***** PAGE = ',I5/)
      WRITE (JUNIT,FMT1) (IXUTM(I),I=IAX,IBX)
```

```
MEMBER NAME  FRADIG
      WRITE (JUNIT,FMT2) (IT(I),I=IA,IB)                                00001210
      DO 300 JJ=1,JSIZE                                                 00001220
      J=(JEND+1)-JJ                                                     00001230
      JUTM=JYUTM(JSIZE+1-JJ)                                            00001240
      DO 410 I=IA,IB                                                    00001250
  410 ID(I)=C(I,J)*RATIO                                                00001260
C     WRITE (JUNIT,8050) JUTM,J,(ID(I),I=IA,IB)                         00001270
C8050 FORMAT (1X,I4,I4,1X,40I3)                                         00001280
      WRITE (JUNIT,FMT3) JUTM,J,(ID(I),I=IA,IB)                         00001290
  300 CONTINUE                                                          00001300
  310 CONTINUE                                                          00001310
      RETURN                                                            00001320
  500 CONTINUE                                                          00001330
C.... THIS WRITES C ON DISK IN CARD IMAGE.                              00001340
C....                                                                   00001350
C.... WRITE C(I,J) ON DISK...                                           00001360
C     DO 400 J=1,IYMAX                                                  00001370
C     WRITE (KUNIT,8060) (C(I,J),I=1,IXMAX)                             00001380
C8060 FORMAT (10F7.5,10X)                                               00001390
  400 CONTINUE                                                          00001400
C     WRITE (KUNIT,8070) DTOT                                           00001410
C8070 FORMAT (F12.6)                                                    00001420
      RETURN                                                            00001430
      END                                                               00001440
      SUBROUTINE GRIDCN(C,IN,JN,IA,JA,DXA,DYA,CC,IM,JM,IB,JB,DXB,DYB,   00001450
     *                  IBM,JBM,IXUTM,JYUTM,L)                          00001460
C....                                                                   00001470
C.... L=1,THIS CONVERTS C(IN,JN) IN UNIFORM GRID INTO CC(IM,JM) IN NON  00001480
C.... UNIFORM GRID.                                                     00001490
C.... L=2, CONVERT CC INTO C.                                           00001500
C.... IA,JA=LOCATION IN CC GRID WHERE GRID SPACECHANGES, EXCEPT         00001510
C.... IA(1),JA(1) DENOTES THE ORIGIN OF CC---CC(1,1)=C(IA(1),JA(1)).    00001520
C.... DX,DY=GRID SPACE WITH INITIAL POINT AT (IA,JA).                   00001530
C....                                                                   00001540
      DIMENSION C(IN,JN),CC(IM,JM),IA(IM),JA(JM),DXB(IBM),DYB(JBM)      00001550
     *          ,IXUTM(IM),JYUTM(JM),IB(IBM),JB(JBM)                    00001560
C....                                                                   00001570
      DXAI=1.0/DXA                                                      00001580
      DYAI=1.0/DYA                                                      00001590
      AREAI=DXAI*DYAI                                                   00001600
      IREC=IA(1)                                                        00001610
      JREC=JA(1)                                                        00001620
      IXREC=IXUTM(1)                                                    00001630
      IYREC=JYUTM(1)                                                    00001640
C.... SET UP THE TABLE FOR INDICIES OF C(I,J).                          00001650
C....                                                                   00001660
      J1=0                                                              00001670
      DO 20 J=1,JBM                                                     00001680
      JINTVL=DYB(J)*DYAI+0.2                                            00001690
      JJEND=JB(J)                                                       00001700
      DO 10 JJ=1,JJEND                                                  00001710
      J1=J1+1                                                           00001720
      IF (J1 .GE. JM) GO TO 20                                          00001730
      JA(J1+1)=JA(J1)+JINTVL                                            00001740
      JYUTM(J1+1)=JYUTM(J1)+JINTVL                                      00001750
   10 CONTINUE                                                          00001760
   20 CONTINUE                                                          00001770
      I1=0                                                              00001780
```

```
MEMBER NAME  FPART4
      DO 40 I=1,IMM
      IINTVL=DXR(I)*DXAI+0.2
      IIEND=IR(I)
      DO 30 II=1,IIEND
      I1=I1+1
      IF (I1 .GE. IM) GO TO 40
      IA(I1+1)=IA(I1)+IINTVL
      IXUTM(I1+1)=IXUTM(I1)+IINTVL
   30 CONTINUE
   40 CONTINUE
C     DEBUG INIT(IA,JA)
C.... TRANSFORM Q(KI,KJ) TO QQ(I,J).
      DO 600 J=1,JM
      KJ=JA(J)
      JJJEND=JINTVL
      IF (J .LT. JM) JJJEND=JA(J+1)-JA(J)
      DO 500 I=1,IM
      KI=IA(I)
      IIIEND=IINTVL
      IF (I .LT. IM) IIIEND=IA(I+1)-IA(I)
C....
C.... AVERAGE THE Q(KI,KJ) TO GET QQ(II,JJ)
      QTOT=0.0
      DO 200 JJJ=1,JJJEND
      KJJ=KJ+JJJ-1
C....
      DO 100 III=1,IIIEND
      KII=KI+III-1
      QTOT=QTOT+Q(KII,KJJ)
  100 CONTINUE
  200 CONTINUE
      QQ(I,J)=QTOT*AREAI
  300 CONTINUE
  400 CONTINUE
  500 CONTINUE
  600 CONTINUE
      RETURN
C     DEBUG INIT (IA,JA,KI,KJ)
      END
```

```
MEMBER NAME  COMBIS
C.... THIS PROGRAM COMBINES SMALL EMISSION SOURCES IN A PLANT
C       TO BE TREATED AS : 1) A SOURCE, IF (QS.GT.150); OR 2) PART
C       OF A LARGE SOURCE IN THE SAME PLANT, IF (QS.LE.150).
C.... QS IS COMBINATED SOURCE EMISSION OF STACK HAVE
C          Q LESS THAN OR EQUAL TO 150 TONS/YEAR.
C.... INPUT DATA SET=IUNIT, IT IS A REDUCED POINT SOURCE DATA FROM NEDS.
C.... THIS PROGRAM ALSO CREATES NEW DATA SETS FOR POINT SOURCE ON
C        I/O UNIT=KUNIT AND KUNIT1
      COMMON NPLANT(270),NSTACK(270),ISTATE(270),ICONTY(270)
     &      ,IPLANT(270),IUTM(270),XP(270),YP(270),ZP(270),IQP(270)
     &      ,SPACE(270),DP(270),TS(270),FR(270),PH(270),ISEA(270,4)
     &      ,AHR(270),NDAY(270),NWEEK(270),ZH4(270)
      DIMENSION NCOMB(20)
      LOGICAL*1 SE(20)
      DATA CP/.24/,RHO/1.29/
      DATA IUNIT/11/,JUNIT/6/,KUNIT/12/,KUNIT1/13/
C *** FORMAT STATEMENTS ***
9000  FORMAT (I4,2I2,2I4,I2,F4.1,F5.1,F4.0,I7,2F7.1,F4.0,F7.0
     &      ,F4.0,5I2,I1,I2)
8600  FORMAT ('1 ***** POINT SOURCE DATA BEFORE SMALL EMISSION SOURCES'
     &      ,' BEING COMBINED *****'//'      .... ALL PARAMETERS ARE'
     &      ,' LISTED IN MKS UNIT, EXCEPT Q IN TONS/YEAR.'//
     &      3X,'N   IP   S ST   CT   IC UTM    X      Y     ZP      D   SP'
     &      ,'   TP     TS   FLOW   PH --ISEA-- HR...      ZH4  '/)
8610  FORMAT (1X,I3,I6,2I3,I5,I4,I6,F6.1,F7.1,F6.1,I7,2F5.1,2F7.1
     &      ,F6.1,1X,4I2,1X,I2,I1,I2,F7.1)
8700  FORMAT ('1 ***** POINT SOURCE DATA SET WITH SMALL SOURCES BEING '
     &      ,'COMBINED *****'//
     &      3X,'N   IP   S ST   CT   IC    X      Y      ZP      D   SP'
     &      ,'   TP    TS   FLOW   PH --ISEA-- HR...      ZH4  ICOMB'/)
9900  FORMAT ('1 ***** DATA ON KUNIT, DSN=COADIS,DATA *****'//)
9910  FORMAT (80A1)
9940  FORMAT ('1 ***** DATA ON KUNIT1, DSN=POSBPT4,DATA *****'//)
9950  FORMAT (5X,80A1)
      CPRHO=CP*RHO*1000.
      U64,R=0.75
      WRITE (JUNIT,8600)
C *** READ POINT SOURCE DATA AND CONVERT TO MKS UNIT ***
C.... ZH4 IS PLUME RISE NORMALIZED BY WIND SPEED, CONCAWE FORMULA
C          IS USED IN THIS COMPUTATION.
      N=0
1000  CONTINUE
      N=N+1
      READ (IUNIT,9000,END=1001) NPLANT(N),NSTACK(N),ISTATE(N)
     &      ,ICONTY(N),IPLANT(N),IUTM(N),XP(N),YP(N),ZP(N),IQP(N)
     &      ,SPACE(N),DP(N),TS(N),FR(N),PH(N),(ISEA(N,K),K=1,4)
     &      ,AHR(N),NDAY(N),NWEEK(N)
      ZP(N)=ZP(N)*0.3048
      DP(N)=DP(N)*0.3048
      IF (TS(N).EQ.0.) GO TO 100
      TS(N)=(TS(N)-32.)*5./9.
100   CONTINUE
      FR(N)=FR(N)*0.0283177/60.
      PH(N)=PH(N)*0.3048
      IF (TS(N).LE.0.) GO TO 110
      IF (FR(N).LE.0.) GO TO 110
      QH=FR(N)*CPRHO*TS(N)
      ZH4(N)=0.175*QH**0.50
```

```
MEMBER NAME  EPARTS
      GO TO 120
110   CONTINUE
      ZR4(N)=0.
120   CONTINUE
      WRITE (JUNIT,8610) N,NPLANT(N),ASTACK(N),ISTATE(N)
     &      ,ICONTY(N),IPLANT(N),IUTM(N),XP(N),YP(N),ZP(N),IQP(N)
     &      ,SPACE(N),DP(N),TS(N),FR(N),PH(N),(ISEA(N,K),K=1,4)
     &      ,NHR(N),NDAY(N),NWEEK(N),ZR4(N)
      GO TO 1000
1001  CONTINUE
        NMAX=N-1
C *** PROCEED TO COMBINE SMALL SOURCES ***
      WRITE (JUNIT,8700)
      NSN=0
      NEW=0
C.... FIND THE SOURCES WITH SAME PLANT ID.
1002  CONTINUE
      JSTACK=0
      DO 140 K=1,20
      MCOMB(K)=0
140   CONTINUE
      MP=0
      M=0
      QS=0.
      HS=0.
      ZRS=0.
      NS=NSN+1
      IF (NS.GT.NMAX) GO TO 1100
      NID=NPLANT(NS)
      NSS=NS+1
      DO  200 N=NSS,NMAX
      IF (NPLANT(N).NE.NID) GO TO 210
200   CONTINUE
210   CONTINUE
      NSP=N-NS
      NSN=N-1
      IF (NSP.LE.1) GO TO 1003
C.... SEARCH FOR Q.LE.150 AND SUM IT TO QS.
      DO 220 N=NS,NSN
      IF (IQP(N).GT.150.) GO TO 220
      M=M+1
      MCOMB(M)=N
      QP=IQP(N)
      QS=QP+QS
      HS=QP*ZP(N)+HS
      ZRS=QP*ZR4(N)+ZRS
220   CONTINUE
      MP=M
      IF (MP.EQ.0) GO TO 300
      IF (QS.GT.150.) GO TO 400
C.... COMBINED SOURCE ADD TO OTHER STACK.
      HEFF=HS/QS+ZRS/(QS*U)
      MM=0
C.... NOW SEARCH FOR A STACK TO BE ADDED TO.
      ZDIFF=9999.
      DO 230 N=NS,NSN
      IF (IQP(N).LE.150) GO TO 230
      MM=MM+1
```

```
MEMBER NAME  CRAPIT
      HDIFF=ZP(N)+ZP4(N)/H
      ZDIFF=ABS(HCDIFF-HDIFF)
      IF (ZDIFFS.LT.ZDIFF) GO TO 330
      ZDIFFS=ZDIFF
      IPOINT=N
330   CONTINUE
      IF (MM.EQ.0) GO TO 500
C.... ADD QS TO Q(IPOINT)
      MP=MP+1
      MCOMB(MP)=IPOINT
      HS=HS+ZP(IPOINT)*IQP(IPOINT)
      ZPS=ZPS+ZP4(IPOINT)*IQP(IPOINT)
      QS=QS+IQP(IPOINT)
      ZP(IPOINT)=HS/QS
      ZP4(IPOINT)=ZPS/QS
      IQP(IPOINT)=QS
      GO TO 600
C *** CREATE A NEW POINT SOURCE DATA SET ***
C.... ONLY ONE STACK IN THIS PLANT, NO CHANGE.
1003  CONTINUE
      CALL WRITER (NS,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,1,NS)
      GO TO 1002
C.... NO STACK IN A PLANT HAS Q LESS THAN 150, NO CHANGE
300   CONTINUE
      DO 310 N=NS,NSN
      CALL WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,1,N)
310   CONTINUE
      GO TO 1002
C.... COMBINED STACK TO BE CONSIDERED AS A SOURCE
400   CONTINUE
      DO 410 N=NS,NSN
      IF (IQP(N).LE.150) GO TO 410
      CALL WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,1,N)
410   CONTINUE
420   CONTINUE
      N=MCOMB(1)
      IQP(N)=QS
      ZP(N)=HS/QS
      ZP4(N)=ZPS/QS
      CALL WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,MP,MCOMB)
      GO TO 1002
C.... NO SOURCE IN THIS PLANT HAS Q LARGER THAN 150.
500   CONTINUE
      GO TO 420
C.... QS ADDED TO Q(IPOINT)
600   CONTINUE
      DO 620 N=NS,NSN
      IF (IQP(N).LE.150) GO TO 620
      IF (N.EQ.IPOINT) GO TO 610
      CALL WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,1,N)
      GO TO 620
610   CONTINUE
      CALL WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,MP,MCOMB)
620   CONTINUE
      GO TO 1002
1100  CONTINUE
      REWIND KUNIT
      REWIND KUNIT1
```

```
MEMBER NAME  FRAPTS
      WRITE (JUNIT,8900)
700   CONTINUE
      READ (KUNIT,8910,END=800) (A(K),K=1,80)
      WRITE (JUNIT,8950) (A(K),K=1,80)
      GO TO 700
800   CONTINUE
      WRITE (JUNIT,8940)
810   CONTINUE
      READ (KUNIT1,8910,END=1110) (A(K),K=1,80)
      WRITE (JUNIT,8950) (A(K),K=1,80)
      GO TO 810
1110  CONTINUE
      STOP
      END
      SUBROUTINE WRITER (N,JSTACK,NEW,JUNIT,KUNIT,KUNIT1,MO,MOLD)
      COMMON NPLANT(270),NSTACK(270),ISTATE(270),ICONTY(270)
     &      ,IPLANT(270),IUTM(270),XP(270),YP(270),ZP(270),IOP(270)
     &      ,SPACE(270),DP(270),TS(270),FR(270),PH(270),ISEA(270,4)
     &      ,NHR(270),NDAY(270),NWEEK(270),ZR4(270)
      DIMENSION MOLD(MO)
      NEW=NEW+1
      JSTACK=JSTACK+1
      WRITE (JUNIT,8710) NEW,NPLANT(N),JSTACK,ISTATE(N)
     &     ,ICONTY(N),IPLANT(N),XP(N),YP(N),ZP(N)
     &     ,IOP(N),SPACE(N),DP(N),TS(N),FR(N),PH(N)
     &     ,(ISEA(N,K),K=1,4),NHR(N),NDAY(N),NWEEK(N)
     &     ,ZR4(N),(MOLD(K),K=1,MO)
      ID=1
      IXP=XP(N)*10.
      IYP=YP(N)*10.
      IZP=ZP(N)*10.
      ISPACE=SPACE(N)*10.
      IDP=DP(N)*10.
      ITS=TS(N)*10.
      IFR=FR(N)*10.
      IPH=PH(N)*10.
      IZR4=ZR4(N)*10.
      ZPH=ZP(N)+PH(N)
      IF (XP(N).LE.0.0) GO TO 100
      IF (YP(N).LE.0.0) GO TO 100
      IF ((ZP(N).LE.0.).AND.(PH(N).LE.0.)) GO TO 100
      IF ((ZR4(N).LE.0.).AND.(PH(N).LE.0.)) GO TO 100
      WRITE (KUNIT1,8820) NEW,XP(N),YP(N),ZPH,IOP(N),ZR4(N)
      GO TO 110
100   CONTINUE
      WRITE (KUNIT1,8830) NEW,XP(N),YP(N),ZPH,IOP(N),ZR4(N)
     &                    ,ID,XP(N),YP(N),ZPH,IOP(N),ZR4(N)
110   CONTINUE
      WRITE (KUNIT,8810) NPLANT(N),JSTACK,ISTATE(N)
     &     ,ICONTY(N),IPLANT(N),IUTM(N),IXP,IYP,IZP
     &     ,IOP(N),ISPACE,IDP,ITS,IFR,IPH
     &     ,(ISEA(N,K),K=1,4),NHR(N),NDAY(N),NWEEK(N)
     &     ,NEW
8710  FORMAT (1X,I3,I4,2I3,I5,I4,F6.1,F7.1,F6.1,I7,2F5.1,2F6.1
     &     ,F8.1,1X,4I2,1X,I2,I1,I2,F7.1,' *',10I3/100X,10I3)
8810  FORMAT (I4,2I2,2I4,I2,I4,I5,I4,I7,2I3,I4,I7,I4,5I2,I1,I2,5X,I3)
8820  FORMAT (I5,3F7.1,I7,F7.1)
8830  FORMAT (2(I5,3F7.1,I7,F7.1))
```

```
[illegible]                                         00002220
      RETURN                                        00002230
      END
```

```
MEMBER NAME  EPAPT6
C.... THIS PROGRAM PRINT OUT POINT SOURCES DATA ACCORDING TO
C         VARIOUS SEQUENCE.
C.... INPUT DATA SET IS REDUCED POINT SOURCE DATA, DSN=EPAPT5.DATA
C     IT ALSO CREATE DATA SET DSN=EPAPT6.DATA FOR MODEL INPUT
      DIMENSION NP(200),XP(200),YP(200),ZP(200),QP(200),ZR(200)
      DIMENSION NP1(200),XP1(200),YP1(200),ZP1(200),QP1(200),ZR1(200)
      DIMENSION IGP(200)
      LOGICAL*1 YES,A(80),IDD(200),ID1(200)
      DATA IUNIT/11/,JUNIT/6/,KUNIT/12/
      DATA IXMAX/200/,IYMAX/140/,XBEG/640./,YBEG/4190./
     &    ,CXBEG/725./,CYBEG/4252./,CXEND/765./,CYEND/4311./
      DATA XCC/745./,YCC/4282./
       DATA YES/'*'/,IDD/200*' '/
      REAL*4 FMTDS(10)/'(I5,','5F10','.1) ',7*'    '/
      WRITE (KUNIT,8010) FMTDS
8010  FORMAT (10A4)
      XEND=XBEG+IXMAX
      YEND=YBEG+IYMAX
      M=1
      QTOT=0.
1000  CONTINUE
      READ (IUNIT,8050,END=1001) NP(M),XP(M),YP(M),ZP(M),QP(M),ZR(M),ID
8050  FORMAT (I5,3F7.1,F7.0,F7.1,I5)
      IF (M.NE.NP(M)) GO TO 2000
      QTOT=QTOT+QP(M)
      IF (ID.EQ.1) IDD(M)=YES
      M=M+1
      GO TO 1000
1001  CONTINUE
      NMAX=M-1
C.... ARRANGE SOURCE ACCORDING TO EMISSION
      DO 110 K=1,NMAX
      QMAX=0.
      DO 100 N=1,NMAX
      IF (QP(N).LE.QMAX) GO TO 100
      QMAX=QP(N)
      MP=N
100   CONTINUE
      NP1(K)=NP(MP)
      XP1(K)=XP(MP)
      YP1(K)=YP(MP)
      ZP1(K)=ZP(MP)
      ZR1(K)=ZR(MP)
      ID1(K)=IDD(MP)
      QP1(K)=QP(MP)
      QP(MP)=0.
110   CONTINUE
      WRITE (JUNIT,8100)
8100  FORMAT ('1*** POINT SOURCE ARRANGED BY EMISSION '//
     &     '    .... (*) INDICATES MISSING DATA IN ORIGINAL FILE'//
     &     '    N',8X,'XP',8X,'YP',8X,'ZP',8X,'QP',8X,'ZR',3X,'NN')
      DO 120 N=1,NMAX
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZR1(N),N
     &      ,ID1(N)
8110  FORMAT (I5,5F10.1,I5,3X,A1)
120   CONTINUE
C.... GROUP SOURCE ACCORDING TO REGION
      INCGP=0
```

```
MEMBER NAME  EPART4
      INAGP=0
      QINC=0.
      QINA=0
      WRITE (JUNIT,8200)
8200  FORMAT ('1*** POINT SOURCE ARRANGED BY REGION ***'//
     &   '     N',8X,'XP',8X,'YP',8X,'ZP',8X,'QP',8X,'ZZ',3X,'NO')
      DO 200 N=1,NMAX
      IGP(N)=3
      IF ((XP1(N).LT.XBEG).OR.(XP1(N).GT.XEND)) GO TO 200
      IF ((YP1(N).LT.YBEG).OR.(YP1(N).GT.YEND)) GO TO 200
      INAGP=INAGP+1
      QINA=QINA+QP1(N)
      IGP(N)=2
      IF ((XP1(N).LT.CXBEG).OR.(XP1(N).GT.CXEND)) GO TO 200
      IF ((YP1(N).LT.CYBEG).OR.(YP1(N).GT.CYEND)) GO TO 200
      INCGP=INCGP+1
      IGP(N)=1
      QINC=QINC+QP1(N)
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZZ1(N)
     &      ,INCGP,ID1(N)
C     WRITE (KUNIT,FMTPS) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZP1(N)
200   CONTINUE
      I=INCGP
      DO 210 N=1,NMAX
      IF (IGP(N).NE.2) GO TO 210
      I=I+1
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZZ1(N)
     &      ,I,ID1(N)
210   CONTINUE
      DO 220 N=1,NMAX
      IF (IGP(N).NE.3) GO TO 220
      I=I+1
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZZ1(N)
     &      ,I,ID1(N)
220   CONTINUE
      QTOTR=1
      QINCR=QINC/QTOT
      QINAR=QINA/QTOT
      WRITE (JUNIT,8210) NMAX,QTOT,QTOTR,INCGP,QINC,QINCR
     &      ,INAGP,QINA,QINAR
8210  FORMAT (///5X,'N',11X,'Q',6X,'RATIO'/
     &      5X,I5,F12.1,F10.4,3X,'--- TOTAL'/
     &      5X,I5,F12.1,F10.4,3X,'--- SOURCE WITHIN COMP. REGION'/
     &      5X,I5,F12.1,F10.4,3X,'--- SOURCE WITHIN AREA SOURCE MAP')
C.... GROUP SOURCE ACCORDING TO X , Y
      WRITE (JUNIT,8300)
8300  FORMAT ('1*** POINT SOURCE ARRANGED BY (I,J) OF TOTAL AREA ***'//
     &   '     N',8X,'XP',8X,'YP',8X,'ZP',8X,'QP',8X,'ZZ',3X,'NO')
      M=0
      DO 310 J=1,IYMAX
      IYY=(J-1)*YREG
      DO 310 I=1,IXMAX
      IXX=(I-1)*XREG
      DO 300 N=1,NMAX
      IF (IGP(N).EQ.4) GO TO 300
      IXP=XP1(N)
      IF (IXX.NE.IXP) GO TO 300
      IYP=YP1(N)
```

```
MEMBER NAME  FRAPT6
      IF (IYY.NE.IYP) GO TO 300
      M=M+1
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZR1(N)
     &      ,M,ID1(N)
      IF (IGP(N).EQ.2) GO TO 300
      WRITE (KUNIT,FMTOS) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZR1(N)
300   CONTINUE
310   CONTINUE
      DO 330 N=1,NMAX
      IF (IGP(N).NE.3) GO TO 330
      M=M+1
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZR1(N)
     &      ,M,ID1(N)
330   CONTINUE
C.... ARRANGE SOURCE ACCORDING TO DISTANCE TO XCC,YCC
      WRITE (JUNIT,8500) XCC,YCC
8500  FORMAT ('1*** POINT SOURCE ARRANGED BY DISTANCE TO (XCC,YCC) ***'/
     &      20X,'(XCC,YCC)=(',F5.1,',',F6.1,')'//
     &   '    N',8X,'XP',8X,'YP',9X,'ZP',8X,'QP',8X,'ZR',3X,'NN',9X,'S')
      M=0
      DO 510 K=1,150
      XK=K
       XKM1=XK-1.
      DO 500 N=1,NMAX
       U=XCC-XP1(N)
       V=YCC-YP1(N)
       DS=SQRT(U*U+V*V)
       IF ((DS.GE.XK).OR.(DS.LT.XKM1)) GO TO 500
      M=M+1
      WRITE (JUNIT,8510) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N)
     &      ,ZR1(N),M,ID1(N),K
8510  FORMAT (I5,5F10.1,I5,3X,A1,I5)
500   CONTINUE
510   CONTINUE
      DO 520 N=1,NMAX
      IF (IGP(N).NE.3) GO TO 520
      M=M+1
      WRITE (JUNIT,8110) NP1(N),XP1(N),YP1(N),ZP1(N),QP1(N),ZR1(N)
     &      ,M,ID1(N)
520   CONTINUE
C.... PRINT DATA ON UNIT=KUNIT
      WRITE (JUNIT,8600)
      REWIND KUNIT
600   READ (KUNIT,8610,END=610) (A(I),I=1,80)
      WRITE (JUNIT,8620) (A(I),I=1,80)
      GO TO 600
610   CONTINUE
8600  FORMAT ('1  *** DATA ON UNIT=KUNIT ***'///)
8610  FORMAT (80A1)
8620  FORMAT (5X,80A1)
2000  CONTINUE
      RETURN
      END
```

```
MEMBER NAME  EPASIA
C.... THIS PROGRAM IS PROVIDED BY EPA. IT COMPUTES UTM COORDINATES
C        FROM GIVEN LAT. AND LONG. COORDINATES.
C.... INPUT IS COORDINATES OF RAPS STATION IN LAT. AND LONG.
C.... UNIT 3 IS CLARK'S TABLE.
C.... FILEDEF 13 DISK (XTENT 6) PERM RECFM FB BLOCK 768)
      IMPLICIT REAL*8 (A-H,O-Z)
      DIMENSION XRAMS(30),YRAMS(30)
      REAL*4 FMTOS(10)/'(3(I','5,F9','.3,F','10.3','))  ',5*'    '/
      LOGICAL*1 KKDATA(80)
       DATA IUNIT/11/,JUNIT/6/,KUNIT/12/
       NS=0
      WRITE (JUNIT,2)
    2 FORMAT('   LATITUDE         LONGITUDE       ZONE    VERTICAL UTM   HOR
     *IZONTAL UTM     CODE'/)
    1 READ(IUNIT,10,END=21)XAT1,XAT2,XAT3,XNG1,XNG2,XNG3
   10 FORMAT(6F3.0)
      NS=NS+1
      XLAT=(XAT3+60.*XAT2+3600.*XAT1)*1.005
      XLNG=(XNG3+60.*XNG2+3600.*XNG1)*(-1.005)
      CALL CEOOCR(XLNG,XLAT,4,MZON,EMNOR,EMEAS,MERR)
      IF(MZON.EQ.15)GO TO 15
      CALL GTCR(1,EMNOR,EMEAS,0)
   15 WRITE(JUNIT,11)XAT1,XAT2,XAT3,XNG1,XNG2,XNG3,MZON,EMNOR
     &       ,EMEAS,MERR
      XRAMS(NS)=EMEAS*0.001
      YRAMS(NS)=EMNOR*0.001
3000  FORMAT (I4,6F4.1,I4,-3P2F10.3)
   11 FORMAT(3F4.0,4X,3F4.0,4X,I3,5X,F10.0,6X,F10.0,7X,I2)
      GO TO 1
21    CONTINUE
      NSTOT=NS
      WRITE (KUNIT,8010) NSTOT
8010  FORMAT (I5)
      WRITE (KUNIT,8100) FMTOS
8100  FORMAT (10A4)
      WRITE (KUNIT,FMTOS) (NS,XRAMS(NS),YRAMS(NS),NS=1,NSTOT)
       WRITE (JUNIT,8050)
8050   FORMAT ('1  *** DATA SET DSN=RPARAMS.DATA ***'//)
       REWIND KUNIT
200   READ (KUNIT,8200,END=300) (KKDATA(K),K=1,80)
8200  FORMAT (80A1)
      WRITE (JUNIT,8210) (KKDATA(K),K=1,80)
8210   FORMAT (5X,80A1)
      GO TO 200
300   CONTINUE
      STOP
      END
      SUBROUTINE CEOOCR(XLNG,XLAT,IND1,     MZON,EMNOR,EMEAS,MERR)
C     MODIFIED BY HAWS, STI, 12/72 FOR ONLY 1 SPHEROID,I.E. WHERE IND2=2
C     GEODETIC POSITION TO UNIVERSAL TRANSVERSE MERCATOR COORDINATES
C     DECH/COMPUTER CONCEPTS
      COMMON/CORD/COORD
      REAL*8 COORD(16,7)  ,EMPHI,EDELTA
      REAL*8 DELTA,ALPHA,DELTAO,DELTA1,BETA
      REAL*8 GAMMA,DDELTA,ETERM
      REAL*8  FIMLAT,FIMLNG,FILNG,FILAT,EMN,EMEAS
      REAL*8 EMNOR,EMEAS,XLNG,XLAT
      MERR=0
```

```
MEMBER NAME  FRASTA
      IF(IND1)1,1,2
    1 MERR=1
      RETURN
    2 IF(IND1-5)3,1,1
    3 GO TO (5,6,7,8),IND1
    5 FILNG=XLNG*78683.7792D0
      FILAT=XLAT*78683.7792D0
      GO TO 13
    6 FILNG=XLNG *.38146972656D0
      FILAT=XLAT *.38146972656D0
      GO TO 13
    7 FILNG=XLNG*2.062648062D0
      FILAT=XLAT*2.062648062D0
      GO TO 13
    8 FILNG = XLNG
      FILAT = XLAT
   13 IF(FILAT)14,15,15
   14 FIMLAT=-FILAT
      GO TO 16
   15 FIMLAT=FILAT
   16 CONTINUE
      IF(FIMLAT-2.88D10) 18,18,17
   17 MERR=2
      RETURN
   18 IF(FILNG)19,20,20
   19 FIMLNG=-FILNG
      GO TO 21
   20 FIMLNG=FILNG
   21 CONTINUE
      IF(FIMLNG-6.48D10) 24,23,22
   22 MERR=3
      RETURN
   23 MZON=1
      GO TO 25
   24 MZON = (FILNG+6.696D10)/2.16D9
   25 CONTINUE
  600 CONTINUE
      IF(FIMLAT-72.D8) 201,202,601
  601 CONTINUE
      IF(FIMLAT-144.D8) 202,203,602
  602 CONTINUE
      IF(FIMLAT-198.D8) 203,204,603
  603 CONTINUE
      IF(FIMLAT-234.D8) 204,205,604
  604 CONTINUE
      IF(FIMLAT-262.8D8) 205,206,605
  605 CONTINUE
      IF(FIMLAT-277.2D8) 206,207,207
  201 J=1
      FMPHI = 360.D7
      GO TO 210
  202 J=2
      FMPHI = 108.D8
      GO TO 210
  203 J=3
      FMPHI = 180.D8
      GO TO 210
  204 J=4
```

```
MEMBER NAME  FRASTA
      EMPHI = 216.D0
      GO TO 210
  205 J=5
      EMPHI = 252.D0
      GO TO 210
  206 J=6
      EMPHI = 270.D0
      GO TO 210
  207 J=7
      EMPHI = 242.6D0
  210 DELTA = (ELMLAT-EMPHI)*.00010D0
      I=6
      ALPHA=COORD(7,J)  +COORD(8,J)  *DELTA
  211 ALPHA=COORD(I,J)  +ALPHA*DELTA
      I=I-1
      IF(I)213,213,211
  213 DELTAO=DELTA*ALPHA
      ETERM = YEAR-31
      DELTAL=(216.07*ETERM   +108.07)-ELONG
      DELTAL=DELTAL*434813681.D-20
      ALPHA=COORD(15,J)  +COORD(16,J)  *DELTAO
      BETA=COORD(16,J)  *DELTAL
      I=14
  215 GAMMA=COORD(I,J)  +ALPHA*DELTAO-BETA*DELTAL
      BDELTA=ALPHA*DELTAL+BETA*DELTAO
      ALPHA=COORD(I-1,J)  +GAMMA*DELTAO-BDELTA*DELTAL
      BETA=GAMMA*DELTAL+BDELTA*DELTAO
      I=I-2
      IF(I-10)220,220,215
  220 GAMMA=COORD(10,J)  +ALPHA*DELTAO-DELTAL*BETA
      BDELTA=ALPHA*DELTAL+BETA*DELTAO
      EMN = COORD(9,J)  +GAMMA*DELTAO-BDELTA*DELTAL
      EMEAS = 5.0D5 -(GAMMA*DELTAL+BDELTA*DELTAO)
 5000 FORMAT(2F25.16)
      IF(XLAT)225,224,224
  225 EMNOR = 1.0D0-EMN
      GO TO 227
  224 EMNOR = EMN
  227 RETURN
      END
      BLOCK DATA
      COMMON / COED/COEF
      REAL*8 COORD(16,7)
      REAL*8 COORD12(16),COORD22(16),COORD32(16),COORD42(16),COORD52(16),
     1    COORD62(16),COORD72(16)
      EQUIVALENCE
     1    (COORD(1,1)  , COORD12(1)) ,(COORD(1,2)  , COORD22(1)),
     2    (COORD(1,3)  , COORD32(1)) ,(COORD(1,4)  ,COORD42(1)),
     3    (COORD(1,5)  , COORD52(1)) ,(COORD(1,6)  ,COORD62(1)),
     4    (COORD(1,7)  , COORD72(1))
      DATA COORD12/ .49906036090D-05, .02117334700D-10,
     1.02060940870D-15, .00213527030D-20, .00133446410D-25,
     2.11321541020D-30, .00010512110D-35, .00032107840D-40,
     3110534 3.10000,.62754354300D07,-.05452062600D07,-.09901650540D07,
     4  .03215780630D07, .02225052750D07, -.00467593700D07,
     5 -.00542527650D07 /
      DATA  COORD22/ .55656750600D-05, .07976345770D-10,
     1.03664106350D-15, .01073515250D-20, .00438107640D-25,
MEMBER NAME  FRASTA
     2.0016151478D-30, .0000656264 8D-35, .0002627691D-40,
     33318605.226D0,.5526156960D07, -.1381539219D07, -.0466043656D07,
     4  .0406929968D07, -.0023737423D07, -.0021961450D07,
     5.0037826746D07 /
      DATA CORD32 / .7521184517D-05, .2184990662D-10,
     1.1135593294D-15, .0576565638D-20, .0323544317D-25,
     2.0186820832D-30, .0111283189D-35, .0067606713D-40,
     35539411.779D0,.4106355473D07, -.1572925396D07, .0118047314D07,
     4 .0195232064D07, -.0105480462D07, .0014959044D07,
     5 .0015131135D07 /
      DATA CORD42/ .9679763520D-05, .4077989432D-10,
     1 .2659560366D-15, .1833896662D-20, .1361507835D-25,
     2 .1050208779D-30, .0933567869D-35, .0675334139D-40,
     3 6651204.6D0,.3195949863D07,  -.1383869379D07, .0266102296D07,
     4 .0059104357D07, -.0067036994D07, .0025292671D07,
     5 -.0002169360D07 /
      DATA CORD52 / 1.4163711560D-05, .9649163773D-10,
     1 .8939144732D-15, .9299525223D-20, 1.0336559489D-25,
     2 1.1963321013D-30, 1.4242120367D-35, 1.7308124042D-40,
     3 7765697.7D0,.2187149430D07, -.1027623620D07, .0279208157D07,
     4 -.0025458841D07, -.0016513695D07, .0012562355D07,
     5 -.0004359447D07 /
      DATA CORD62 / 1.9723215513D-05, 1.6953882434D-10,
     1 2.1175151210D-15, 2.9368156655D-20, 4.3557493117D-25,
     2 6.7219060366D-30, 10.6695415012D-35, 17.2986054901D-40,
     3 9323452.6D0,.1655376293D07, -.0799485147D07, .0238924408D07,
     4 -.0039827738D07, -.0003223536D07, .0005528952D07,
     5 -.0002522388D07 /
      DATA CORD72/ 2.4310555817D-05, 2.8981418519D-10,
     1 4.6990991563D-15, 8.5193855196D-20, 16.4479412690D-25,
     2 33.1014282702D-30, 68.5329853109D-35, 144.8462561026D-40,
     3 9714033.1D0, .1275252086D07, -.0624925325D07, .0195643581D07,
     4 -.0039646076D07, .0002575786D07, .0002080265D07,
     5 -.0001257142D07 /
      END
      SUBROUTINE GTGR(NARGS,CN,CF,IW)
      DIMENSION P1(9,9),NR(61)
      REAL*8 P1,A1,RN,RF,CNP,CFP,A,B,C,D,CN,CF,V1
      DEFINE FILE 3(61,768,L,IJK)
      DATA NR/20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,
     1        39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,
     2        58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,
     3        77,78,79,80/
      A1 = CN/100000.0
      IN = A1 + .5
      RN = IN * 100000
      A1 = CF/100000.0
      IF = A1 + .5
      RF = IF * 100000
      CNP = (CN-RN)*.00001
      CFP = (CF-RF)*.00001
      DO 40 I=1,61
      IF (NR(I).EQ.IN) GO TO 50
   40 CONTINUE
   50 IBLOCK = I
      READ(3'IBLOCK) P1
      IF (IW.EQ.1) GO TO 60
      IF (IW.EQ.0) GO TO 70
```

```
MEMBER NAME  CDASTA
   60 IF = 10 - IF                                                      00002330
      GO TO 80                                                          00002340
   70 V1 = -1.0                                                         00002350
      B1(IF,2) = B1(IF,2) * V1                                          00002360
      B1(IF,4) = B1(IF,4) * V1                                          00002370
      B1(IF,6) = B1(IF,6) * V1                                          00002380
      B1(IF,8) = B1(IF,8) * V1                                          00002390
   80 A =(B1(IF,5)+((CNP*B1(IF,7))-(CFP*B1(IF,8))))                    00002400
      B =(B1(IF,6)+((CNP*B1(IF,8))+(CFP*B1(IF,7))))                    00002410
      C =(B1(IF,3)+((CNP*A)-(CFP*B)))                                   00002420
      D =(B1(IF,4)+((CNP*B)+(CFP*A)))                                   00002430
      CN =(B1(IF,1)+((CNP*C)-(CFP*D)))                                  00002440
      CF =(500000.0*B1(IF,2)+((CNP*D)+(CFP*C)))                         00002450
      RETURN                                                            00002460
      END                                                               00002470
```

```
MEMBER NAME  EPAAREA1
C.... THIS READS IN EPA NEDS AREA SOURCES DATA (TON/YEAR)
C.... IN NON-UNIFORM GRID AND CONVERT THEM INTO UNIFORM
C.... GRID FOR 1-KM GRID.
C.... IXBEG,IYBEG=ORIGIN OF THE GRIDS,IXMAX,IYMAX=AREA SIZE IN KM.
C.... QA=AREA SOURCE STRENTH.
      DIMENSION Q(200,140), IQ(200)
      DATA Q/28000*0.0/,IUNIT/5/,JUNIT/6/,KUNIT/11/,IFORM/25/
     *    ,IXBEG/640/,IYBEG/4190/,IXMAX/200/,IYMAX/140/
      IPT=IXMAX/IFORM
      ICARD=0
      QTOT=0.
C.... START THE LOOP TO READ IN DATA..
1000  CONTINUE
      READ (IUNIT,8010) X,Y,SIZE,QA
8010    FORMAT (2F7.1,F5.1,24X,F12.4)
      IF (X.GE.999.) GO TO 1001
      ICARD=ICARD+1
      IX=X
      IY=Y
      ISIZE=SIZE
      KX=IX-IXBEG+1
      KY=IY-IYBEG+1
      IF (ISIZE.EQ.1) GO TO 110
      KXEND=KX+ISIZE-1
      KYEND=KY+ISIZE-1
      DO 100 I=KX,KXEND
      DO 100 J=KY,KYEND
      IF (Q(I,J).GT.0.0) WRITE (JUNIT,8020) ICARD,I,J
8020  FORMAT (' DUPLICATED SOURCE AT : ICARD,I,J = ',3I5)
      Q(I,J)=QA
C     QTOT=QTOT+QA
100    CONTINUE
      GO TO 120
110   CONTINUE
      IF (Q(KX,KY).GT.0.0) WRITE (JUNIT,8020) ICARD,KX,KY
      Q(KX,KY)=QA
C     QTOT=QTOT+QA
120   CONTINUE
      GO TO 1000
1001  CONTINUE
C.... COMPLETE THE READ LOOP..
C.... SUM THE TOTAL SOURCE QTOT.
      DO 200 J=1,IYMAX
      DO 200 I=1,IXMAX
  200 QTOT=QTOT+Q(I,J)
      WRITE (JUNIT,8030) ICARD,QTOT
8030  FORMAT (' *** NUMBER OF AREA SOURCES = ',I4,' ***'/
     &         ' *** TOTAL SOURCE EMISSION = ',F12.6, ' ***')
C....
C.... PRINT OUT Q ARRAY.
      DO 310 IP=1,IPT
      IA=(IP-1)*IFORM+1
      IB=IA+IFORM-1
      WRITE (JUNIT,8040) IP,(I,I=IA,IB)
      DO 300 JJ=1,IYMAX
      J=(IYMAX+1)-JJ
8040    FORMAT ('1  ***** PAGE = ',I5,/6X,25I5//)
      DO 410 I=IA,IB
```

```
MEMBER NAME  FPAAREA1
  410 IO(I)=Q(I,J)*1000.                                                    00000590
      WRITE (JUNIT,8050) J,(IO(I),I=IA,IB)                                  00000600
8050    FORMAT (1X,I4,1X,25I5)                                              00000610
300    CONTINUE                                                             00000620
310    CONTINUE                                                             00000630
C....                                                                       00000640
C.... WRITE Q(I,J) ON DISK...                                               00000650
      DO 400 J=1,IYMAX                                                      00000660
C     WRITE (KUNIT,8060) (Q(I,J),I=1,IXMAX)                                 00000670
8060   FORMAT (10F7.5,10X)                                                  00000680
400    CONTINUE                                                             00000690
C     WRITE (KUNIT,8070) QTOT                                               00000700
8070   FORMAT (F12.6)                                                       00000710
      RETURN                                                                00000720
C     //X.FT11F001 DD DSN=JCS4165.FPAAREA1.DATA,DISP=SHR                    00000730
C     //X.SYSIN DD DSN=JCS4165.FPAAREA1.DATA,DISP=SHR                       00000740
      END                                                                   00000750
```

```
MEMBER NAME  FRASEC7
      DIMENSION ZSA(30),ZSB(30),ZSC(30),IZSC(30)
      DATA KUNIT/11/,KUNIT2/12/,JUNIT/6/,KUNIT3/13/
C.... READ IN ZSB(TERRAIN HEIGHT) AND ZSA(TOTAL TERRAIN PLUS BUILDING
C.... HEIGHT) AND GET ZSC(BUILDING HEIGHT)
  100 CONTINUE
      READ (KUNIT,8000,END=250)IX,IY,ID,IDX,NMAX,ZSA
 8000 FORMAT(I3,I4,2I1,I2,1X,30F2.0)
      WRITE (JUNIT,8010) IX,IY,ID,IDX,NMAX,(ZSA(I),I=1,NMAX)
      READ(KUNIT2,8000,END=250)IX,IY,ID,IDX,NMAX,ZSB
      DO 200 I=1,NMAX
  200 ZSC(I)=ZSA(I)-ZSB(I)
      WRITE (JUNIT,8020) IX,IY,ID,IDX,NMAX,(ZSB(I),I=1,NMAX)
 8010 FORMAT (/,1X,I4,I5,2I2,I3,21F4.0)
      WRITE (JUNIT,8020) IX,IY,ID,IDX,NMAX,(ZSC(I),I=1,NMAX)
 8020 FORMAT (1X,I4,I5,2I2,I3,21F4.0)
      DO 300 I=1,NMAX
  300 IZSC(I)=ZSC(I)
C     WRITE (KUNIT3,8030)IX,IY,ID,IDX,NMAX,(IZSC(I),I=1,NMAX)
 8030 FORMAT (I3,I4,2I1,I2,1X,21I2)
      GO TO 100
  250 CONTINUE
      STOP
      END
```

```
MEMBER NAME  EPAAREA2
C..... THIS READS IN EPA NEDS AREA SOURCES DATA (TON/YEAR)
C..... IN UNIFORM 1-KM GRID AND CHOOSE A SUB-AREA FOR ANALYSIS.
C..... IXBEG,IYBEG=ORIGIN OF THE GRIDS IN UTM,IXMAX,IYMAX=AREA SIZE IN KM
C..... QA,Q(200,140)=AREA SOURCE STRENGTH.
C..... IBEG,JBEG=ORIGIN OF THE SUB-AREA
C..... ISIZE,JSIZE= SIZE OF THE SUB-AREA.
C..... IXUTM,JYUTM=ARRAY OF UTM POSITION.
C..... IA,JA =INDEX ARRAY OF THE NON-UNIFORM GRIDS.
C..... DXB,DYB=GRID SIZE OF THE NON-UNIFORM GRIDS.
C..... ZS(200,140)= TEMP. ARRAY FOR ZSS &ZSBG.
C..... ZSS=AVERAGED TERRAIN HEIGHT(M). ZSBG=BUILDING HEIGHT.
C..... Z0=AREA SOURCE EMISSION HEIGHT OR ROUGHNESS (M).
C.....
      DIMENSION ZS(200,140), Q(200,140),IXUTM(200),JYUTM(140),II(200)
     *          ,IA(200),JA(140)
      EQUIVALENCE (ZS(1,1),Q(1,1))
      DATA ZS/28000*-1.0/,IUNIT/5/,JUNIT/6/,KUNIT/11/,IFORM/40/
     *    ,IXBEG/640/,IYBEG/4192/,IXMAX/200/,IYMAX/140/,KUNIT2/12/
     *    ,IBEG/86/,JBEG/63/,ISIZE/40/,JSIZE/60/,DXA/1./,DYA/1./
C..... COMPUTED ARRAYS.
      DIMENSION ZSS(30,40),ZSBG(30,40),Z0(30,40),QQ(30,40)
     *          ,DXB(30),DYB(40)
      DATA IM/30/,JM/40/,DXB/5*2.,20*1.,5*2.0/,DYB/10*2.,20*1.,10*2./
     *    ,RATIO/1.0/,LSUM/0/
      REAL*4 TITLE1(10)/'AREA',' SOU','RCES',' IN ','XXXX',5*'    '/
     *      ,TITLE2(10)/'TERR','AIN ','HEIG','T IN',' M  ',5*'    '/
     *      ,TITLE3(10)/'ROUG','HNES','S IN',' CM ',6*'    '/
     *      ,TITLE4(10)/'AREA',' SOU','RCES',' EMI','SSIO','N HT',
     *                  ' IN ','M   ',2*'    '/
     *      ,TITLE5(10)/'BUIL','DING',' HT ','IN M',6*'    '/
     *      ,FMTDS1(10)/'(10F','7.5,','10X)',7*'    '/
     *      ,FMTDS2(10)/'(18F','4.1,',' 8X)',7*'    '/
     *      ,FMTDS3(10)/'(18F','4.2,',' 8X)',7*'    '/
C.....
C..... READ IN Q(200,140) AND CONVERT TO QQ(30,40).
      CALL READQQ(Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXBEG,IYBEG,
     *     IXUTM,JYUTM,JUNIT,KUNIT,SQTOT)
      RATIO=0.0
      CALL WRITEQ(Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM,IFORM
     *        ,JUNIT,II,RATIO,TITLE1,FMTDS1)
      IA(1)=IBEG
      JA(1)=JBEG
      CALL GRIDCN(Q,IXMAX,IYMAX,IA,JA,DXA,DYA,QQ,IM,JM,DXB,DYB,
     *            IXUTM,JYUTM,1,LSUM)
      CALL WRITEQ(QQ,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,II,RATIO
     *          ,TITLE1,FMTDS1)
C     WRITE (14,FMTDS1) QQ
C     WRITE (14,8000) SQTOT
 8000 FORMAT(F10.5)
C.....
C..... READ IN SURFACE HEIGHT ZSA AND EXPAND THEM TO ZS(200,140)
C..... AND PUT IN ZSS(30,40) FOR KK=1; ZSBG FOR KK=2.
      DO 100 KK=1,2
      CALL READZS(ZS,IXMAX,IYMAX,IXBEG,IYBEG,JUNIT,KUNIT2)
C..... PRINT ZS IN THE GIVEN REGION AND COMPUTED REGION.
      DO 200 K=1,2
C..... BUKEVICH'S REGION BEGINS AT (75,66).
      IBEG=75
```

```
MEMBER NAME  EPAAREA2
      JBEG=66
      ISIZE=50
      JSIZE=50
      IF ( K .LT. 2) GO TO 110
      IBEG=86
      JBEG=63
      ISIZE=40
      JSIZE=60
  110 CONTINUE
      DO 300 J=1,JSIZE
  300 JYUTM(J)=IYBEG+JBEG+J-2
      DO 310 I=1,ISIZE
  310 IXUTM(I)=IXBEG+IBEG+I-2
      RATIO=1.0
      CALL WRITEO(ZS,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM,IFORM
     *        ,JUNIT,II,RATIO,TITLE2,FMTDS2)
  200 CONTINUE
      IA(1)=IBEG
      JA(1)=JBEG
      IF (KK .EQ. 2) GO TO 220
      CALL GRIDCN(ZS,IXMAX,IYMAX,IA,JA,DXA,DYA,ZSS,IM,JM,DXB,DYB,
     *        IXUTM,JYUTM,1,LSUM)
      CALL WRITEO(ZSS,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,II,RATIO
     *        ,TITLE2,FMTDS2)
      GO TO 100
  220 CONTINUE
      CALL GRIDCN(ZS,IXMAX,IYMAX,IA,JA,DXA,DYA,ZSBG,IM,JM,DXB,DYB,
     *            IXUTM,JYUTM,1,LSUM)
      CALL WRITEO(ZSBG,IM,JM,IM,JM,1,1,IXUTM JYUTM,IM,JUNIT,II,RATIO
     *        ,TITLE5,FMTDS2)
  100 CONTINUE
C.... CALCULATE EFFECTIVE HEIGHT EMISSION HEIGHT FOR AREA SOURCES.
      DO 400 J=1,JM
      DO 400 I=1,IM
  400 ZO(I,J)=ZSBG(I,J)+10.0
      CALL WRITEO(ZO,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,II,RATIO
     *        ,TITLE4,FMTDS3)
C....
C.... CALCULATE SURFACE ROUGHNESS ZO(30,40) FROM ZSS AND OO.
C.... ZO=0.5*(ZSS+5)*(0.04*(1.+1.0*OO/SQTOT)).
      SQTOTI=1.0/SQTOT
      DO 500 J=1,JM
      DO 500 I=1,IM
      ZOZS=0.04*(1.0+1200.0*OO(I,J)*SQTOTI)
      ZO(I,J)=0.5*ZOZS*(ZSBG(I,J)+0.2*ZSS(I,J)+5.0)
  500 CONTINUE
      RATIO=0.0
      CALL WRITEO(ZO,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,II,RATIO
     *        ,TITLE3,FMTDS3)
C     WRITE (14,FMTDS3) ZO
      STOP
      END
      SUBROUTINE READZS(ZS,IXMAX,IYMAX,IXBEG,IYBEG,JUNIT,KUNIT)
      DIMENSION ZS(IXMAX,IYMAX),ZSA(30)
C.... THIS READS IN BUKOVICH'S DATA ON TERRAIN HEIGHT(ZSA) AND
C.... BUILDING HEIGHT(ZSC) AND CALCULATE THE EFFECTIVE HT.
C....
      WRITE (JUNIT,8020) KUNIT
```

```
MEMBER NAME  EPAAREA2
 8020 FORMAT('1     *** READ IN BUKOVICH DATA OF TERRAIN AND BUILDING HEI
     *HT IN HIS GRID REGION FROM UNIT= ',I4)
C.... INITIALIZE ZS=-1.0.
      DO 50 J=1,IYMAX
      DO 50 I=1,IXMAX
   50 ZS(I,J)=-1.0
  100 CONTINUE
      READ (KUNIT,8000,END=250)IX,IY,ID,IDX,NMAX,ZSA
C     READ (13,   8000,END=250)IX,IY,ID,IDX,NMAX,ZSC
 8000 FORMAT(I3,I4,2I1,I2,1X,30F2.0)
      WRITE (JUNIT,8010) IX,IY,ID,IDX,NMAX,(ZSA(I),I=1,NMAX)
C     WRITE (JUNIT,8010) IX,IY,ID,IDX,NMAX,(ZSC(I),I=1,NMAX)
 8010 FORMAT (1X,I4,I5,2I2,I3,21F4.0)
C.... READ ONE CARD AND PUT THEM INTO ZS(KX,KY)
      DO 110 N=1,NMAX
      J1=(ID+1)/2
      I1=ID+1-J1*2
      JX=IX+(N-1)*IDX*I1
      JY=IY+(N-1)*IDX*J1
      KI=JX-IXBEG+1
      KJ=JY-IYBEG+1
      DO 120 J2=1,IDX
      KJJ=KJ-(IDX/2)+J2-1
      DO 120 I2=1,IDX
      KII=KI-(IDX/2)+I2-1
      ZS(KII,KJJ)=ZSA(N)
  120 CONTINUE
  110 CONTINUE
      GO TO 100
  250 CONTINUE
C.... FILL UP THE VOID REGION BY LINEAR INTERPOLATION.
      DO 400 J=76,103,27
      DO 400 I=86,111
  400 ZS(I,J)=0.5*(ZS(I,J-1)+ZS(I,J+1))
      DO 410 I=85,112,27
      DO 410 J=76,103
  410 ZS(I,J)=0.5*(ZS(I-1,J)+ZS(I+1,J))
      C13=1.0/3.0
      C23=2.0/3.0
      DO 420 J=70,108,38
      DO 420 I=81,116
      ZS(I,J)=C23*ZS(I,J-1)+C13*ZS(I,J+2)
  420 ZS(I,J+1)=C23*ZS(I,J+2)+C13*ZS(I,J-1)
      DO 430 I=79,117,38
      DO 430 J=70,109
      ZS(I,J)=C23*ZS(I-1,J)+C13*ZS(I+2,J)
  430 ZS(I+1,J)=C23*ZS(I+2,J)+C13*ZS(I-1,J)
      DO 440 J=80,100
      I=88
      ZS(I,J)=0.5*ZS(I-1,J)+0.5*ZS(I+1,J)
      DO 440 I=89,109
  440 ZS(I,J)=0.5*ZS(I,J)+0.5*ZS(I+1,J)
      DO 450 I=88,109
      J=79
      ZS(I,J)=0.5*ZS(I,J-1)+0.5*ZS(I,J+1)
      DO 450 J=80,100
  450 ZS(I,J)=0.75*ZS(I,J)+0.25*ZS(I,J+1)
      DO 460 J=119,122
```

```
MEMBER NAME  EPAAREA2
      DO 460 I=75,126
  460 ZS(I,J)=ZS(I,117)
      RETURN
      END
      SUBROUTINE WRITEO (O,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM
     *                  ,IFORM,JUNIT,II,RATIO,TITLE,FMTDS)
C.... THIS WRITES O(ISIZE,JSIZE) ON UNIT=JUNIT IN FORM=IFORM.
C.... IFORM=NO. OF COLUMES TO BE PRINTED ON ONE LINE.
C....
      DIMENSION RFMT1(10),RFMT2(10),RFMT3(10),TITLE(10),FMTDS(10)
      LOGICAL*1 FMT1(40),FMT2(40),FMT3(40),FM(8)
      EQUIVALENCE (FM(1),IFM1),(FM(5),IFM2)
     * ,(FMT1(1),RFMT1(1)),(FMT2(1),RFMT2(1)),(FMT3(1),RFMT3(1))
      DATA RFMT1/'(5X,','5HXU','TM=,','40I3','   )',5*'    '/
     *    ,RFMT2/'(5X,','5H  ',' I=,','40I3',',/ )',5*'    '/
     *    ,RFMT3/'(1X,','2I4,','1X ,','40I3','   )',5*'    '/
      DIMENSION O(IXMAX,IYMAX),IXUTM(ISIZE),JYUTM(JSIZE) ,II(ISIZE)
     *          ,IO(200)
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
      IF (IFORM .EQ. 0) GO TO 500
      IFM1=120/IFORM+240
      IFM2=IFORM/10+240
      FMT1(16)=FM(4)
      FMT2(16)=FM(4)
      FMT3(16)=FM(4)
      FMT1(13)=FM(8)
      FMT2(13)=FM(8)
      FMT3(13)=FM(8)
      IPT=(ISIZE-1)/IFORM+1
      IF (RATIO .NE. 0.0) GO TO 100
      RATIO=1000.0
      IF (IFORM .GE. 30) RATIO=100.
C     IF (IFORM .GE. 40) RATIO=10.0
  100 CONTINUE
C.... PRINT THE TITLE SPECIFIED.
      WRITE (JUNIT,8000) TITLE
 8000 FORMAT (1H1,'    *****  TITLE= ',10A4)
      DO 310 IP=1,IPT
      IA=(IP-1)*IFORM+IBEG
      IB=IA+IFORM-1
      DO 320 I=IA,IB
      II(I)=I
      IF((II(I).GT. 100) .AND.(IFORM.GT. 30))II(I)=II(I)-100
  320 CONTINUE
      IAX=IA-IBEG+1
      IBX=IAX+IFORM-1
C     WRITE (JUNIT,8040) IP,(IXUTM(I),I=IAX,IBX),(II(I),I=IA,IB)
C8040 FORMAT('0  ***** PAGE = ',I5,/5X,'IUTM=',40I3,/,5X,'   I=',40I3//)
      WRITE (JUNIT,8040) IP
 8040 FORMAT (/,'  ***** PAGE = ',I5/)
      WRITE (JUNIT,FMT1) (IXUTM(I),I=IAX,IBX)
      WRITE (JUNIT,FMT2) (II(I),I=IA,IB)
      DO 300 JJ=1,JSIZE
      J=(JEND+1)-JJ
      JUTM=JYUTM(JSIZE+1-JJ)
      DO 410 I=IA,IB
  410 IO(I)=O(I,J)*RATIO
```

```
MEMBER NAME  FPAAPCA2
C      WRITE (JUNIT,8050) JUTY,J,(IQ(I),I=IA,IB)
C8050 FORMAT (1X,I4,I4,1X,40I2)
       WRITE (JUNIT,FMT2) JUTY,J,(IQ(I),I=IA,IB)
  300 CONTINUE
  310 CONTINUE
      RETURN
  500 CONTINUE
C.... THIS WRITES Q ON DISK IN CARD IMAGE USING FORMAT=FMTOS....
C....
C.... WRITE Q(I,J) ON DISK...
C     DO 400 J=1,IYMAX
C     WRITE (JUNIT,8060) (Q(I,J),I=1,IXMAX)
C8060 FORMAT (10F7.5,10X)
C     WRITE (JUNIT,FMTOS) (Q(I,J),I=1,IXMAX)
  400 CONTINUE
      WRITE (JUNIT,FMTOS) Q
      WRITE (6,8010) TITLE
 8010 FORMAT(/,'  *****  TITLE =',10A4,' HAS BEEN WRITTEN ON DISK')
      RETURN
      END
      SUBROUTINE GRIDCN(Q,IN,JN,IA,JA,DXA,DYA,QQ,IM,JM,DXB,DYB,
     *                  IXUTM,JYUTM,L,LSUM)
C....
C.... L=1,THIS CONVERTS Q(IN,JN) IN UNIFORM GRID INTO QQ(IM,JM) IN NON
C.... UNIFORM GRID.
C.... L=2, CONVERT QQ INTO Q.
C.... LSUM=1,TAKE SUM; LSUM=0,TAKE AVERAGE.
C.... IA,JA=LOCATION IN QQ GRID WHERE GRID SPACECHANGES, EXCEPT
C.... IA(1),JA(1) DENOTES THE ORIGIN OF QQ---QQ(1,1)=Q(IA(1),JA(1)).
C.... DX,DY=GRID SPACE WITH INITIAL POINT AT (IA,JA).
C....
      DIMENSION Q(IN,JN),QQ(IM,JM),IA(IM),JA(JM),DXB(IM),DYB(JM)
     *          ,IXUTM(IM),JYUTM(JM)
C....
      DXAI=1.0/DXA
      DYAI=1.0/DYA
      AREAI=DXAI*DYAI
      IBEG=IA(1)
      JBEG=JA(1)
      IXBEG=IXUTM(1)
      IYBEG=JYUTM(1)
C.... SET UP THE TABLE FOR INDICIES OF Q(I,J).
C....
      JM1=JM-1
      IM1=IM-1
      DO 20 J=1,JM1
      JINTVL=DYB(J)*DYAI+0.2
      JA(J+1)=JA(J)+JINTVL
      JYUTM(J+1)=JYUTM(J)+JINTVL
   20 CONTINUE
      DO 40 I=1,IM1
      IINTVL=DXB(I)*DXAI+0.2
      IA(I+1)=IA(I)+IINTVL
      IXUTM(I+1)=IXUTM(I)+IINTVL
   40 CONTINUE
C     DEBUG INIT(IA,JA)
C.... TRANSFORM Q(KI,KJ) TO QQ(I,J).
      DO 600 J=1,JM
```

```
MEMBER NAME  EPAAREA2
      KJ=JA(J)
      JJJEND=DYB(J)*DYAI+0.2
      DO 500 I=1,IM
      KI=IA(I)
      IIIEND=DXB(I)*DXAI+0.2
C....
C.... AVERAGE THE Q(KI,KJ) TO GET QQ(II,JJ)
      IF (LSUM .EQ. 0) AREAI=1.0/(DXB(I)*DYB(J))
      QTOT=0.0
      DO 200 JJJ=1,JJJEND
      KJJ=KJ+JJJ-1
C....
      DO 100 III=1,IIIEND
      KII=KI+III-1
      QTOT=QTOT+Q(KII,KJJ)
  100 CONTINUE
  200 CONTINUE
      QQ(I,J)=QTOT*AREAI
  300 CONTINUE
  400 CONTINUE
  500 CONTINUE
  600 CONTINUE
      RETURN
C     DEBUG INIT (IA,JA,KI,KJ)
      END
      SUBROUTINE READQQ(Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXBEG,IYBEG,
     *            IXUTM,JYUTM,JUNIT,KUNIT,SQTOT)
C.... THIS READS IN EPA NEDS AREA SOURCES DATA (TON/YEAR)
C.... IN UNIFORM 1-KM GRID AND CHOOSE A SUB-AREA FOR ANALYSIS.
C.... IXBEG,IYBEG=ORIGIN OF THE GRIDS IN UTM,IXMAX,IYMAX=AREA SIZE IN KM
C.... QA,Q(200,140)=AREA SOURCE STRENTH.
C.... IBEG,JBEG=ORIGIN OF THE SUB-AREA
C.... ISIZE,JSIZE= SIZE OF THE SUB-AREA.
C....
      DIMENSION Q(IXMAX,IYMAX), IXUTM(IXMAX),JYUTM(IYMAX)
C....
C.... READ IN Q(200,140) AND QTOT.
      REWIND KUNIT
      DO 100 J=1,IYMAX
      READ (KUNIT,8060) (Q(I,J),I=1,IXMAX)
 8060 FORMAT (10F7.5,10X)
  100 CONTINUE
      READ (KUNIT,8070) QTOT
 8070 FORMAT (F12.6)
C....
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
      ITOT=ISIZE*JSIZE
C.... SUM THE TOTAL SOURCE QTOT FOR SUB-AREA.
      SQTOT=0.0
      DO 200 J=JBEG,JEND
      DO 200 I=IBEG,IEND
  200 SQTOT=SQTOT+Q(I,J)
      RQTOT=SQTOT/QTOT
      WRITE (JUNIT,8030) ITOT,SQTOT,QTOT,RQTOT
 8030 FORMAT (' *** NUMBER OF AREA SOURCES = ',I10,' ***'/
     &        ' *** TOTAL SOURCE EMISSION & RATIO= ',3G13.5, ' ***')
C....
```

```
MEMBER NAME  EPAAREA2
      DO 300 J=1,JSIZE
  300 JYUTM(J)=IYBEG+JBEG+J-2
      DO 310 I=1,ISIZE
  310 IXUTM(I)=IXBEG+IBEG+I-2
      RETURN
      END
```

```
MEMBER NAME  EPAGE01
C.... THIS PROGRAM CREATES GEOGRAPHY AND ANNUAL EMISSION DATA
C       ON UNIT=KUNIT, DSN=EPAGE01.DATA
      DIMENSION XP(200),YP(200),ZP(200),QP(200),ZR(200),NN(200)
      DIMENSION FMTDS(10)
      REAL*4 FMTDS1(10)/'(3(I','5,F6','.1,F','7.1,','F6.1','))  '
     &                          ,4*'    '/
     &      ,FMTDS2(10)/'(9F8','.2) ',9*'    '/
     &      ,FMTDS3(10)/'(12F','6.1)',9*'    '/
      LOGICAL*1 A(80)
      DATA IXREG/640/,IYREG/4190/,IREG/86/,JREG/63/
      DATA IUNIT1/11/,IUNIT2/12/,IUNIT3/13/,IUNIT4/14/
      DATA IUNIT/10/,JUNIT/6/,KUNIT/15/
      WRITE (KUNIT,8010) IXREG,IYREG,IREG,JREG
8010  FORMAT (4I5)
10    READ (IUNIT,8000,END=100) (A(I),I=1,80)
      WRITE (KUNIT,8000) (A(I),I=1,80)
      GO TO 10
100   READ (IUNIT1,8000,END=200) (A(I),I=1,80)
      WRITE (KUNIT,8000) (A(I),I=1,80)
8000  FORMAT (80A1)
      GO TO 100
200   READ (IUNIT2,8000,END=300) (A(I),I=1,80)
      WRITE (KUNIT,8000) (A(I),I=1,80)
      GO TO 200
300   CONTINUE
      READ (IUNIT3,8300) FMTDS
8300  FORMAT (10A4)
      N=1
      QPTOT=0.
302   READ (IUNIT3,FMTDS,END=400) NN(N),XP(N),YP(N),ZP(N),QP(N),ZR(N)
      QP(N)=QP(N)*0.02876664
      QPTOT=QPTOT+QP(N)
      N=N+1
      GO TO 302
400   CONTINUE
      NMAX=N-1
      WRITE (KUNIT,8310) NMAX
      WRITE (KUNIT,8300) FMTDS1
      WRITE (KUNIT,FMTDS1) (NN(K),XP(K),YP(K),ZP(K),K=1,NMAX)
8310  FORMAT (I5)
500   READ (IUNIT4,8000,END=600) (A(I),I=1,80)
      WRITE (KUNIT,8000) (A(I),I=1,80)
      GO TO 500
600   CONTINUE
      WRITE (KUNIT,8300) FMTDS2
      WRITE (KUNIT,FMTDS2) (QP(K),K=1,NMAX)
      WRITE (KUNIT,8620) QPTOT
      WRITE (KUNIT,8300) FMTDS3
      WRITE (KUNIT,FMTDS3) (ZR(K),K=1,NMAX)
8620  FORMAT (F10.1)
C.... PRINT DATA SET ON UNIT=KUNIT.
      REWIND KUNIT
      WRITE (JUNIT,8630)
8630  FORMAT ('1 ***** DATA ON UNIT=KUNIT *****'///)
700   READ (KUNIT,8000,END=800) (A(I),I=1,80)
      WRITE (JUNIT,8700) (A(I),I=1,80)
8700  FORMAT (5X,80A1)
      GO TO 700
```

```
MEMBER NAME  EPAGEN1                                                                          00000590
800    CONTINUE                                                                               00000600
       STOP                                                                                   00000610
       END
```

```
MEMBER NAME  EPAGEOIN
C
      DIMENSION QB(30,40),ZS(30,40),ZO(30,40)
     &     ,PQB(150),XP(150),YP(150),ZP(150),ZR(150),NP(150)
     &     ,XRAMS(25),YRAMS(25),IRAMS(25)
     &     ,IXUTM(30),JYUTM(40),DXB(30),DYB(40)
      DATA DXB/5*2.,20*1.,5*2./,DYB/10*2.,20*1.,10*2./
      DATA IM/30/,JM/40/,LM/150/,NS/25/
      CALL GEOIN (QB,ZS,PQB,XP,YP,ZP,ZR,ZO,NP,XRAMS,YRAMS,IRAMS
     &     ,IXUTM,JYUTM,DXB,DYB,IM,JM,LM,LMM,NS,NRAMS)
      NS=NRAMS
      LM=LMM
      STOP
      END
       SUBROUTINE GEOIN (QB,ZS,PQB,XP,YP,ZP,ZR,ZO,NP,XRAMS,YRAMS,IRAMS
     &                 ,IXUTM,JYUTM,DXB,DYB,IM,JM,LM,LMMAX,NS,NRAMS)
C.... THIS ROUTINE READ IN GEOGRAPHICAL AND ANNUAL EMISSION DATA.
C     IT ALSO: 1) FIX UTM COORDINATES FOR ALL NUMERICAL GRIDS.
C              2) PRINT DATA SETS
C              3) CONVERT LOCATION OF POINT SOURCE TO NUMERICAL GRID.
      DIMENSION QB(IM,JM),ZS(IM,JM),ZO(IM,JM)
     &     ,PQB(LM),XP(LM),YP(LM),ZP(LM),ZR(LM),NP(LM)
     &     ,XRAMS(NS),YRAMS(NS),IRAMS(NS)
     &     ,IXUTM(IM),JYUTM(JM),DXB(IM),DYB(JM)
       DIMENSION FMTDS(10)
      DATA JUNIT/6/,KUNITG/15/
      DATA RATIO/1.0/,DXA/1.0/,DYA/1.0/
      REAL*4 TITLE1(10)/'AREA',' SOU','RCES',' IN ','????',5*'    '/
     *      ,TITLE2(10)/'ROUG','HNES','S IN',' M  ',6*'    '/
     *      ,TITLE3(10)/'AREA',' SOU','RCES',' EMI','SSIO','N HT',
     *                  ' IN ',' M  ',2*'    '/
C.... READ ORGIN OF UMT COORDINATE AND FIX FOR ALL GRIDS.
      READ (KUNITG,8000) IXREG,IYREG,IREG,JREG
8000  FORMAT (4I5)
      CALL XYUTMS (IXUTM,JYUTM,IXREG,IYREG,IREG,JREG,DXB,DYB,DXA,DYA
     &            ,IM,JM)
C.... READ IN UTM COORDINATES OF RAMS STATIONS
      READ (KUNITG,8030) NRAMS
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) (IRAMS(L),XRAMS(L),YRAMS(L),L=1,NRAMS)
C.... PRINT AND CONVERT RAMS LOCATION TO NUMERICAL GRID
      WRITE (JUNIT,8015) NRAMS
8015  FORMAT ('1 ***** LOCATION OF ',I2,' RAMS STATIONS *****'//
     &      '   IS',4X,'XRAMS',5X,'YRAMS',6X,'XS',6X,'YS')
      DO 100 L=1,NRAMS
      XI=XRAMS(L)
      YJ=YRAMS(L)
      CALL XYUTM1 (XI,YJ)
      WRITE (JUNIT,8020) IRAMS(L),XRAMS(L),YRAMS(L),XI,YJ
8020  FORMAT (I5,2F10.2,2F8.2)
      XRAMS(L)=XI
      YRAMS(L)=YJ
100   CONTINUE
C.... READ IN SURFACE ROUGHNESS AND PRINT
      READ (KUNITG,8010) FMTDS
8010  FORMAT (10A4)
      READ (KUNITG,FMTDS) ZO
      RATIO=0.0
      CALL WRITEO (ZO,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,RATIO,TITLE2)
```

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MEMBER NAME  FRAGFDIN
C.... READ IN AREA SOURCE EMISSION HEIGHT AND PRINT.
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) ZS
      RATIO=1.0 '
      CALL WRITEO (ZS,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,RATIO,TITLE3)
C.... READ IN POINT SOURCES LOCATION AND STACK HEIGHT.
      READ (KUNITG,8030) LMMAX
8030  FORMAT (I5)
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) (NP(L),XP(L),YP(L),ZP(L),L=1,LMMAX)
C.... READ IN AREA SOURCE EMISSION RATES AND PRINT.
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) QB
      READ (KUNITG,8050) QBTOT
8050  FORMAT (F10.4)
      RATIO=0.0
      CALL WRITEO (QB,IM,JM,IM,JM,1,1,IXUTM,JYUTM,IM,JUNIT,RATIO,TITLE1)
      WRITE (JUNIT,8070) QBTOT
8070  FORMAT (//5X,'.... TOTAL EMISSION = ',F10.2)
C.... READ IN POINT SOURCE EMISSION RATES.
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) (QOB(L),L=1,LMMAX)
      READ (KUNITG,8090) QOBTOT
8090  FORMAT (F10.1)
C.... READ IN PLUME RISE DATA.
      READ (KUNITG,8010) FMTDS
      READ (KUNITG,FMTDS) (ZR(L),L=1,LMMAX)
C.... PRINT POINT SOURCE DATA.
      WRITE (JUNIT,8200) LMMAX
8200  FORMAT ('1 *** POINT SOURCE DATA ***'/
     &        5X,'..... TOTAL NUMBER =',I5//
     &        '   ID',8X,'XP',8X,'YP',8X,'ZP',8X,'QP',8X,'ZR',6X,'XI'
     &         ,6X,'YJ')
C.... CONVERT XP,YP FROM UTM COORDINATE TO NUMERICAL GRID
      DO 200 L=1,LMMAX
      XI=XP(L)
      YJ=YP(L)
      CALL XYUTM1 (XI,YJ)
      WRITE (JUNIT,8210) NP(L),XP(L),YP(L),ZP(L),QOB(L),ZR(L),XI,YJ
8210  FORMAT (I5,3F10.1,F10.2,F10.1,2F8.2)
      XP(L)=XI
      YP(L)=YJ
200   CONTINUE
      WRITE (JUNIT,8070) QOBTOT
      RETURN
      END
      SUBROUTINE XYUTMS (IXUTM,JYUTM,IXBEG,IYBEG,IBEG,JBEG,DXB,DYB
     &                   ,DXA,DYA,IM,JM)
C.... THIS ROUTINE COMPUTES UTM COORDINATES FOR ALL NUMERICAL GRIDS.
C.... ENTRY XYUTM1 CONVERT (X,Y) FROM UTM COORDINATES TO NUMERICAL GRID.
      DIMENSION IXUTM(IM),JYUTM(JM),DXB(IM),DYB(JM)
      IM1=IM-1
      JM1=JM-1
      DXAI=1.0/DXA
      DYAI=1.0/DYA
      IXUTM(1)=IXBEG+IBEG-1
      JYUTM(1)=IYBEG+JBEG-1
      DO 20 J=1,JM1
```

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MEMBER NAME  EPAGEOIN
      JINTVL=DYB(J)*DYAI+0.2
      JYUTM(J+1)=JYUTM(J)+JINTVL
20    CONTINUE
      DO 40 I=1,IM1
      IINTVL=DXB(I)*DXAI+0.2
      IXUTM(I+1)=IXUTM(I)+IINTVL
40    CONTINUE
      RETURN
C
      ENTRY XYUTM1 (XI,YJ)
C
      LXI=XI
      LYJ=YJ
      IF ((LXI.LT.IXUTM(1)).OR.(LXI.GT.(IXUTM(IM)+DXB(IM)))) GO TO 90
      IF ((LYJ.LT.JYUTM(1)).OR.(LYJ.GT.(JYUTM(JM)+DYB(JM)))) GO TO 90
      DO 60 J=1,JM
      IF (LYJ.GE.JYUTM(J)) GO TO 60
      YJJ=J-1
      DY=(YJ-JYUTM(J-1))/DYB(J-1)
      YJ=YJJ+DY
      GO TO 62
60    CONTINUE
62    CONTINUE
      DO 80 I=1,IM
      IF (LXI.GE.IXUTM(I)) GO TO 80
      XII=I-1
      DX=(XI-IXUTM(I-1))/DXB(I-1)
      XI=XII+DX
      GO TO 82
80    CONTINUE
82    CONTINUE
      RETURN
90    CONTINUE
      XI=-1.0
      YJ=-1.0
      RETURN
      END
      SUBROUTINE WRITEQ (Q,IXMAX,IYMAX,ISIZE,JSIZE,IBEG,JBEG,IXUTM,JYUTM
     *                  ,IFORM,JUNIT,RATIO,TITLE)
C.... THIS WRITES Q(ISIZE,JSIZE) ON UNIT=JUNIT IN FORM=IFORM.
C.... IFORM=NO. OF COLUMNS TO BE PRINTED ON ONE LINE.
C....
      DIMENSION RFMT1(10),RFMT2(10),RFMT3(10)
      DIMENSION TITLE(10),FMTDS(10)
      LOGICAL*1 FMT1(40),FMT2(40),FMT3(40),FM(8)
      EQUIVALENCE (FM(1),IFM1),(FM(5),IFM2)
     * ,(FMT1(1),RFMT1(1)),(FMT2(1),RFMT2(1)),(FMT3(1),RFMT3(1))
      DATA RFMT1/'(5X,','5HXU','TM=,','40I3','    )',5*'    '/
     *    ,RFMT2/'(5X,','5H  ',' I=,','40I3',',/ )',5*'    '/
     *    ,RFMT3/'(1X,','2I4,','1X ,','40I3','    )',5*'    '/
      DIMENSION Q(IXMAX,IYMAX),IXUTM(ISIZE),JYUTM(JSIZE)
     *          ,IQ(200),II(200)
      JEND=JBEG+JSIZE-1
      IEND=IBEG+ISIZE-1
      IF (IFORM .EQ. 0) GO TO 500
      IFM1=120/IFORM+240
      IFM2=IFORM/10+240
      FMT1(16)=FM(4)
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MEMBER NAME  FRAGFOIN
      FMT2(16)=FM(4)
      FMT3(16)=FM(4)
      FMT1(13)=FM(8)
      FMT2(13)=FM(8)
      FMT3(13)=FM(9)
      IPT=(ISIZE-1)/IFORM+1
      IF (RATIO.NE.0.0) GO TO 100
      RATIO=1000.0
      IF (IFORM .GE. 30) RATIO=100.
 100   CONTINUE
C.... PRINT THE SPECIFIED TITLE
      WRITE (JUNIT,8000) TITLE
8000  FORMAT ('1   ***** TITLE= ',10A4)
      DO 310 IP=1,IPT
      IA=(IP-1)*IFORM+IBEG
      IB=IA+IFORM-1
      DO 320 I=IA,IB
      II(I)=I
      IF((II(I).GT. 100) .AND.(IFORM.GT. 30))II(I)=II(I)-100
  320 CONTINUE
      IAX=IA-IBEG+1
      IBX=IAX+IFORM-1
C     WRITE (JUNIT,8040) IP,(IXUTM(I),I=IAX,IBX),(II(I),I=IA,IB)
C8040 FORMAT('1  ***** PAGE = ',I5,/5X,'IUTM=',40I3,/,5X,'   I=',40I3//)
      WRITE (JUNIT,8040) IP
 8040 FORMAT ('   ***** PAGE = ',I5/)
      WRITE (JUNIT,FMT1) (IXUTM(I),I=IAX,IBX)
      WRITE (JUNIT,FMT2) (II(I),I=IA,IB)
      DO 300 JJ=1,JSIZE
      J=(JEND+1)-JJ
      JUTM=JYUTM(JSIZE+1-JJ)
      DO 410 I=IA,IB
  410 IO(I)=Q(I,J)*RATIO
C     WRITE (JUNIT,8050) JUTM,J,(IO(I),I=IA,IB)
C8050 FORMAT (1X,I4,I4,1X,40I3)
      WRITE (JUNIT,FMT3) JUTM,J,(IO(I),I=IA,IB)
  300 CONTINUE
  310 CONTINUE
      RETURN
  500 CONTINUE
C.... THIS WRITES Q ON DISK IN CARD IMAGE.
C....
C.... WRITE Q(I,J) ON DISK...
C     DO 400 J=1,IYMAX
C     WRITE (KUNIT,8060) (Q(I,J),I=1,IXMAX)
C8060 FORMAT (10F7.5,10X)
  400 CONTINUE
C     WRITE (KUNIT,8070) QTOT
C8070 FORMAT (F12.6)
      RETURN
      END
```

```
MEMBER NAME  FRAMAP
      LOGICAL*1 M(150,200),N(150,200),NO,YES
      DIMENSION MX(10)
      DATA NO/' '/,YES/'1'/
      DATA JUNIT/6/,KUNIT/11/,KUNIT1/12/
      DO 801 I=1,150
      DO 801 J=1,200
      N(I,J)=NO
801   M(I,J)=NO
      DO 200 J=1,200
      READ (KUNIT,850) JJ,(M(I,J),I=1,75)
  850 FORMAT (I3,2X,75A1)
      READ (KUNIT,850) JJ,(M(I,J),I=76,150)
  200 CONTINUE
      ISHIFT=26
      IIMAX=150-ISHIFT
      DO 300 J=1,200
      JJ=J
      DO 300 I=1,IIMAX
      II=I+ISHIFT
      N(I,J)=M(II,JJ)
  300 CONTINUE
      DO 701 K=1,2
      WRITE (JUNIT,491)
491   FORMAT (1H1)
      I1=(K-1)*75+1
      I2=(K-1)*75+75
      DO 702 JJ=1,200
      J=201-JJ
      WRITE (JUNIT,492) (M(I,J),I=I1,I2)
492   FORMAT(5X,75A1)
702   CONTINUE
701   CONTINUE
      DO 600 K=1,5
      I1=(K-1)*30+1
      I2=(K-1)*30+30
      WRITE (JUNIT,691) (I,I=I1,I2)
691   FORMAT (1H1,4X,30(1X,I3))
      WRITE (JUNIT,692)
      DO 601 JJ=1,200
      J=201-JJ
692   FORMAT (6X,119('_'))
      WRITE (JUNIT,693) J,(M(I,J),I=I1,I2)
693   FORMAT (2X,I3,30('|',2X,A1),'|'/5X,30('|___'),'|')
601   CONTINUE
      WRITE (JUNIT,691) (I,I=I1,I2)
600   CONTINUE
      DO 650 J=1,200
C     WRITE (KUNIT1,891) J,(M(I,J),I=1,75)
891   FORMAT (I3,',1',75A1)
C     WRITE (KUNIT1,892) J,(M(I,J),I=76,150)
892   FORMAT (I3,',2',75A1)
650   CONTINUE
      STOP
      END
```

3. Input Data Listing - Geographical and Annual Emission Data Set

```
MEMBER NAME  EPAGE02
  640 4190   86   63
   25
(3(I5,F9.3,F10.3))
    1   744.183  4279.862      2   742.518  4286.044      3   747.588  4282.466
    4   747.312  4277.304      5   743.706  4276.452      6   738.660  4277.565
    7   740.179  4282.610      8   748.407  4291.102      9   755.802  4279.886
   10   747.208  4272.826     11   738.812  4272.478     12   733.938  4280.912
   13   737.738  4289.819     14   744.320  4297.456     15   757.111  4297.799
   16   762.777  4290.082     17   760.560  4272.818     18   743.065  4263.256
   19   729.759  4270.547     20   723.079  4285.908     21   732.414  4302.375
   22   741.631  4329.222     23   777.320  4286.378     24   749.275  4236.537
   25   697.445  4282.239
(18F4.2,8X)
0.480.320.330.330.260.190.190.190.190.190.190.190.290.290.290.290.290.29
0.290.290.280.280.280.280.280.280.280.270.270.270.490.320.330.330.270.19
0.190.190.190.190.190.190.290.290.290.280.280.280.280.280.290.290.290.29
0.290.290.280.280.280.280.490.330.330.330.270.200.200.200.200.200.190.19
0.280.280.280.280.280.280.280.280.300.300.300.300.300.300.290.290.290.29
0.490.350.360.370.310.240.200.200.200.200.250.250.270.440.640.290.290.29
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0.270.250.230.230.230.230.240.240.300.310.310.310.360.360.370.370.310.31
0.310.320.350.350.340.340.460.530.540.490.480.530.300.270.250.250.230.23
0.240.250.330.320.320.320.380.380.380.380.320.320.320.320.350.350.340.34
0.460.550.580.540.520.580.320.290.260.240.210.240.240.350.420.330.330.30
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0.560.280.290.160.150.260.260.660.660.380.380.240.240.240.240.260.310.32
0.320.300.350.471.191.280.520.540.500.450.420.350.440.420.830.220.170.22
0.250.570.590.320.310.220.210.230.230.270.320.340.340.370.441.020.970.81
0.560.550.510.700.420.370.571.531.031.380.360.160.200.360.350.430.450.40
0.400.410.360.420.380.380.380.440.920.740.470.530.570.590.600.450.420.39
0.581.621.911.751.470.190.120.270.410.530.450.300.320.390.361.040.380.38
0.380.520.670.420.460.490.790.980.920.840.750.391.182.131.892.612.590.71
0.210.220.330.470.310.200.270.330.700.550.260.260.260.700.490.420.450.44
1.121.091.200.660.612.453.792.211.862.773.112.990.990.280.360.500.370.28
0.320.360.760.440.260.310.260.380.360.780.450.440.810.930.890.902.394.57
4.421.551.784.492.932.792.560.650.360.340.400.300.301.060.540.450.810.26
0.800.860.380.450.450.390.530.630.490.410.580.962.871.401.441.164.074.09
2.511.810.390.320.661.341.150.980.320.290.660.880.980.370.360.450.450.39
0.710.470.570.681.170.881.811.511.744.172.393.312.073.310.570.320.481.72
2.191.111.300.960.360.240.240.250.490.340.370.350.500.750.610.600.992.23
1.750.762.591.621.231.900.910.630.910.380.400.951.611.660.551.040.360.24
0.480.240.280.290.300.310.570.520.510.701.010.450.450.451.241.440.712.12
1.002.251.330.430.450.401.411.450.901.190.770.600.240.240.680.290.300.31
0.540.530.530.590.590.720.430.802.673.452.073.424.902.770.680.300.380.43
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5.023.292.403.364.203.383.393.311.290.290.540.440.370.340.290.500.330.17
0.170.230.290.350.410.300.660.720.760.720.792.042.433.703.183.762.733.65
3.052.310.790.290.370.410.320.240.210.200.180.310.170.230.290.360.410.30
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0.622.981.652.302.693.152.030.580.400.400.940.750.200.150.160.170.180.17
0.300.240.360.660.630.420.640.910.800.650.640.810.951.141.092.331.260.45
0.510.160.260.371.171.290.440.150.150.150.150.150.150.190.320.480.870.71
0.720.880.790.830.921.001.000.852.281.540.960.650.370.130.230.490.370.77
0.350.240.240.190.150.330.150.190.320.390.740.490.720.970.790.790.690.74
0.810.752.100.860.830.620.250.110.160.280.880.841.311.040.700.190.150.15
0.150.190.320.350.350.530.611.010.900.790.760.770.730.630.651.711.720.37
0.240.110.110.230.340.801.150.841.480.470.150.150.150.190.320.350.350.38
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MEMBER NAME  EPACEO2
0.710.770.860.790.750.730.610.580.940.570.460.350.310.130.130.170.250.25
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0.450.680.530.480.490.480.510.190.190.150.150.170.180.220.960.390.730.17
0.590.220.340.380.380.380.530.820.990.730.630.850.650.600.720.660.510.43
0.510.260.230.150.150.150.170.220.430.570.170.370.200.210.330.370.370.37
0.490.661.170.640.610.550.540.660.680.550.530.480.530.500.250.200.200.20
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0.410.570.590.410.410.410.400.390.220.220.220.220.160.160.290.150.150.22
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0.460.240.230.240.250.250.210.270.280.280.260.250.250.250.250.250.250.25
0.160.470.350.630.250.540.520.300.230.230.240.230.550.280.270.310.250.25
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0.320.210.250.250.290.340.340.570.240.240.240.24
(18F4.1,8X)
19.018.018.018.015.012.012.012.012.012.012.012.010.010.010.010.010.010.0
10.010.010.010.010.010.010.010.010.010.010.010.019.018.018.018.015.012.0
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19.218.418.518.415.813.312.512.512.512.511.811.810.210.210.210.210.210.2
10.210.210.210.210.210.210.210.511.712.012.012.019.820.120.520.119.218.7
14.514.514.514.511.211.210.810.810.810.810.810.810.810.810.810.810.810.8
10.811.413.514.014.014.020.020.521.020.520.020.015.015.015.015.011.011.0
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20.020.420.820.420.019.315.515.015.014.011.011.811.813.013.012.012.010.8
10.810.910.811.111.511.511.511.913.614.014.014.020.020.020.020.020.017.0
17.015.015.011.011.014.014.019.019.015.015.010.010.010.010.011.012.012.0
12.012.313.714.014.014.020.020.020.020.020.019.319.319.416.513.012.213.3
14.118.118.114.814.311.611.112.012.012.813.513.513.513.613.914.014.014.0
20.020.120.120.020.020.020.020.019.818.614.012.113.815.414.914.314.813.9
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(9F8.2)
 1174.17 1127.57  615.01  196.74    7.11   37.66    1.27    1.24    1.04
   27.07   49.80   45.16   43.29   31.21   28.91   14.97   14.87   13.87
  154.19    0.72   39.35   46.54    9.32    6.47    3.14   91.36   97.94
   70.98   67.72   22.58    0.20  100.63   40.79   37.54   20.31   12.28
   36.59   36.59   36.59   12.34   11.23    4.34    0.55    0.12   49.19
    1.50   13.35  134.34   79.40   70.19   68.46   52.07    7.49   41.60
  332.40  263.59   68.92   67.03   66.39   57.50   54.60   52.70    3.14
  195.33  168.54    0.03    0.49    3.28   15.53    0.5815909.64    5.55
    5.55    4.55    2.24    1.35  135.78    2.65   74.10   63.52   15.07
   11.51    9.38    6.90    6.26    6.30    6.30    6.19    5.61   96.63
   80.78   46.20   46.20   46.20   46.20   43.01   42.72   42.72   42.63
   31.38   31.38   30.23   29.37   26.32   19.96   14.79   12.80   12.56
   11.77   11.77   11.54    9.58    9.58    9.26    9.15    8.72    8.66
    7.07    5.98    5.67    5.38    5.39    5.38    4.57 1720.91  693.51
  278.66 1681.87 1640.59    0.06   51.94   51.72   48.39   42.00   36.99
   36.99   25.96   13.20   12.66    5.24    4.63    4.55    5.72  242.19
  149.47   92.04   56.93   51.58    7.05    3.34
   30286.6
(12F6.1)
1062.51013.4 730.7 730.7  84.0 233.3   0.0  32.6   0.0 259.8  94.4 233.7
 228.4 146.1 169.6 193.9 193.9 149.3   0.0   0.0 218.8 171.6 319.5 185.0
 550.3 209.7 209.0 122.0 118.9 121.7  37.2 198.9 126.7 121.5 114.7 113.9
 943.1 942.0 981.11185.31149.7 542.1   0.0   0.0 370.4   0.0 153.1 996.6
 503.4 503.4 503.4  59.8  55.3 469.7 558.2 558.2 397.7 386.1 386.1 385.9
 386.1 397.7 550.3 270.7 260.6   0.0 190.6  99.6  78.6  75.1 300.0  40.0
```

```
MEMBER NAME  FRAGFO2
  40.0  88.0  70.0 101.5 720.8 768.8 210.4 261.0 201.5 190.6 216.8 195.6
 176.8 261.8 234.7 238.2 183.1 704.6 858.9 334.7 334.7 324.9 324.9 632.1
 325.0 325.0 367.6 270.7 270.7 163.0 605.7 304.0 495.3 391.4 325.9 371.7
 301.0 301.0 335.4 473.7 473.7 293.7 239.5 462.9 150.0 314.9 237.8 235.5
 282.9 282.9 278.2 118.2 779.2 585.3 433.41210.01210.0   0.0 793.1 277.0
 383.6 145.3 240.8 240.8 195.9 116.4  50.0 311.2 311.2 311.2 385.0 533.3
 231.3 208.5 100.0 277.4  73.8  57.8
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4. Output Sample

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          ZRPQ=0.6,ZRISE=1.0,PMAX=0.5,PMIN=0.15,DCMIN=2.0,DLMIN=30.,
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  CARDS COPIED TO DISK.
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             ***** LOCATION OF 25 RAMS STATIONS *****

              IS     XSUTM     YSUTM      XS       YS    JXS   JYS
               1    744.18   4279.86    14.18    17.86    15    18
               2    742.52   4286.04    12.52    24.04    13    25
               3    747.59   4282.46    17.59    20.46    18    21
               4    747.31   4277.30    17.31    15.30    18    16
               5    743.71   4276.45    13.71    14.45    14    15
               6    738.66   4277.57     8.66    15.57     9    16
               7    740.18   4282.61    10.18    20.61    11    21
               8    748.41   4291.10    18.41    29.10    19    30
               9    755.80   4279.89    25.40    17.89    26    18
              10    747.21   4272.82    17.21    10.82    18    11
              11    738.81   4272.48     8.81    10.48     9    11
              12    733.94   4280.91     4.47    18.91     5    19
              13    737.74   4289.82     7.74    27.82     8    28
              14    744.32   4297.46    14.32    32.73    15    33
              15    757.11   4297.80    26.06    32.90    27    33
              16    762.78   4290.08    28.89    28.08    29    29
              17    760.56   4272.82    27.78    10.82    28    11
              18    743.06   4263.26    13.06     5.63    14     6
              19    729.76   4270.55     2.38     9.27     3    10
              20    723.08   4285.91    -0.96    23.91     1    24
              21    732.41   4302.37     3.71    35.19     4    36
              22    741.63   4329.22    11.63    48.61    12    40
              23    777.32   4286.38    36.16    24.38    30    25
              24    749.27   4236.54    19.27    -7.73    20     1
              25    697.45   4282.24   -13.78    20.24     1    21
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4308  39     12  14  14  14  12  11  11  11  11  11  11  11  10  10  10  10  10  10  10  10  14  14  14  14  14  14  13  12  12  12
4306  38     12  14  14  14  12  11  11  11  11  11  11  11  10  10  10  10  10  10  10  10  14  14  14  14  14  14  13  12  12  12
4304  37     12  14  14  14  12  11  11  11  11  11  11  11  10  10  10  10  10  10  10  10  14  14  14  14  14  14  13  12  12  12
4302  36     12  14  14  14  12  11  11  11  11  11  11  11  10  10  10  10  10  10  10  10  14  14  14  14  14  14  13  12  12  12
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4296  33     14  15  16  17  17  17  16  16  16  16  16  16  15  15  12  12  12  12  10  10  11  11  11  11  11  12  15  16  16  16
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4292  31     16  16  16  18  18  19  18  18  18  18  18  17  17  16  13  12  12  12  11  11  11  11  11  11  11  12  15  16  16  16
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4280  19     20  20  18  20  19  19  20  21  21  20  21  20  20  21  18  18  22  22  19  18  18  16  15  15  15  14  11  11  11  11
4279  18     20  20  19  20  20  20  21  21  21  22  22  22  22  22  19  19  21  20  19  19  19  17  15  15  15  14  11  11  11  11
4278  17     20  20  20  20  20  20  22  22  22  21  21  21  21  22  19  18  20  20  19  19  19  17  15  15  15  14  11  11  11  11
4277  16     20  20  20  21  20  20  21  20  20  20  20  20  20  21  19  19  20  20  19  19  19  17  15  15  15  14  11  11  11  11
4276  15     20  20  20  20  20  20  20  21  20  20  20  20  20  19  18  20  20  20  19  19  19  17  16  16  16  15  11  11  11  11
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4274  13     20  20  20  20  20  20  20  20  21  20  20  20  17  17  20  21  16  13  16  18  18  17  16  16  16  15  14  14  14  14
4273  12     20  20  20  20  20  20  20  20  20  20  20  16  12  14  19  19  14  11  14  16  16  16  16  16  16  15  14  14  14  14
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4270  10     20  20  20  20  20  20  20  20  19  18  14  12  13  15  14  14  14  13  14  14  14  14  15  15  15  14  14  14  14  14
4268   9     20  20  20  20  20  19  19  18  16  13  12  13  14  18  18  14  14  11  11  12  12  12  13  13  13  13  13  14  14  14
4266   8     20  20  20  20  20  17  17  15  15  11  11  14  14  19  19  15  15  10  10  10  10  11  12  12  12  12  13  14  14  14
4264   7     20  20  20  20  20  19  15  15  15  14  11  11  11  13  13  12  12  10  10  10  10  11  11  11  11  11  13  14  14  14
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4260   5     19  20  20  20  19  18  14  14  14  14  11  11  10  10  10  10  10  10  10  10  10  10  10  10  10  11  13  14  14  14
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4308  39   20  26  27  27  25  25  25  25  25  25  25  25  16  47  35  62  25  54  51  30  23  23  24  23  55  27  26  31  25  25
4306  38   20  26  27  27  25  25  25  25  25  25  24  24  14  16  14  24  17  17  14  16  68  76  63  23  45  24  23  24  25  25
4304  37   22  27  26  26  25  25  25  25  25  25  24  24  14  14  14  14  14  16  14  14  23  41  43  70  31  29  23  24  24  24
4302  36   22  27  26  26  25  25  25  25  25  25  24  24  14  14  14  14  14  14  14  14  25  25  33  29  37  23  23  24  24  24
4300  35   22  27  26  26  25  25  25  25  25  25  24  24  14  14  14  14  14  14  14  14  24  24  35  23  25  32  23  24  30  45
4298  34   23  36  44  45  38  41  26  26  31  31  27  27  18  18  16  17  17  17  16  16  22  22  22  22  22  23  27  30  30  48
4296  33   36  43  43  62  70  55  37  52  37  50  41  41  37  36  22  20  20  20  16  16  17  17  17  17  17  19  31  36  36  38
4294  32   39  43  43  60  68  50  41  56  58  41  41  41  39  38  22  22  22  22  16  16  29  14  14  22  14  18  31  36  37  36
4292  31   49  66 117  63  61  55  54  66  69  55  52  48  52  50  25  19  19  19  14  17  17  18  16  24  16  19  32  37  37  37
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4290  29   70  77  49  64  57  52  44  68  52  48  49  48  50  18  18  14  14  17  18  22  86  38  73  17  58  22  32  37  37  37
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4288  27   61 101  89  79  75  76  73  62  64 171 172  37  24  11  11  23  33  80 114  83 147  47  14  14  14  18  31  35  35  37
4287  26   72  97  79  79  68  74  81  75 210  86  82  62  25  11  16  27  87  83 131 103  69  18  14  14  14  18  31  35  35  52
4286  25   72  87  79  82  92 100 100  85 227 153  95  64  37  12  23  49  37  76  35  24  24  18  14  32  14  18  31  38  74  49
4285  24   63  91  80  64  63  81  94 114 109 232 126  44  50  16  25  37 117 128  43  14  14  14  14  14  14  18  31  48  87  70
4284  23   60  74  70  68  57  61  62 297 164 230 268 314 202  57  39  39  93  75  19  14  16  17  18  17  30  24  36  66  62  42
4283  22   61  81  68  69  68  72 417 385 397 293 290 264 303 117  54  31  68  56  24  20  20  19  18  17  17  24  36  68 100  36
4282  21   66  72  75  72  79 203 243 369 318 376 272 364 305 231  79  29  37  41  31  24  20  19  18  31  17  23  29  36  41  30
4281  20   55  57  51  68  62 227 502 328 239 335 419 338 339 331 128  29  54  43  37  33  29  50  32  17  17  23  29  35  41  30
4280  19   54  52  52  58  56  72  43  80 267 348 206 342 489 277  68  30  37  43  37  33  95  70  76  81  24  29  30  35  41  30
4279  18   56  51  50  69 101  44  44  44 123 143  70 211 100 225 132  43  44  39 140 144  89 118  76  60  24  24  68  29  30  31
4278  17   50  75  61  60  99 222 175  75 259 161 122 189  91  62  91  37  39  94 160 165  55 103  36  24  48  24  27  29  30  31
4277  16   70  47  56  68 117  87 181 151 173 417 239 331 206 331  56  31  48 172 218 110 130  95  36  24  24  25  49  33  37  35
4276  15   52  62  49  41  57  95 286 139 143 115 406 409 251 181  38  31  66 134 114  98  31  29  66  87  98  37  36  44  44  38
4275  14   81  93  88  89 239 456 442 155 177 448 293 278 256  64  36  33  39  30  30 106  54  44  81  25  80  86  37  44  44  38
4274  13  111 109 119  66  61 244 378 221 185 277 310 298  99  27  36  50  37  27  31  36  75  43  25  31  25  37  36  77  44  43
4273  12   79  98  92  83  75  38 118 213 189 260 259  70  20  22  32  47  31  19  26  32  69  55  25  25  25  69  49  42  44  43
4272  11   56  58  60  44  42  38  57 161 190 175 147  18  12  26  41  52  44  30  31  38  36 103  27  37  37  51  67  42  45  49
4270  10   56  55  50  69  42  37  56 152 102 138  36  16  19  36  35  43  44  39  39  41  36  42  37  37  37  43  92  74  47  52
4268   9   51  54  50  44  42  35  43  42  82  22  17  22  25  56  58  31  31  22  20  23  23  26  31  33  33  37  43 102  97  81
4266   8   48  56  60  57  55  50  56  27  29  16  14  25  25  66  66  37  37  24  24  24  24  25  31  31  31  30  35  47 118 127
4264   7   45  55  57  54  51  57  31  29  25  24  20  24  24  35  42  32  32  30  33  33  33  33  31  31  31  31  33  35  64  51
4262   6   45  52  54  49  48  52  30  26  25  25  23  23  24  25  32  31  31  31  37  37  37  37  31  31  31  31  35  35  33  33
4260   5   48  47  48  44  43  45  26  25  23  23  23  23  24  24  30  31  31  31  36  36  37  37  31  31  31  31  35  35  33  33
4258   4   49  35  36  37  31  24  19  19  19  19  25  25  26  43  63  29  29  29  30  30  31  31  30  30  30  30  31  31  32  32
4256   3   49  32  32  32  26  19  19  19  19  19  18  18  27  27  27  27  27  27  27  27  30  30  30  30  30  30  29  29  29  29
4254   2   49  31  32  32  26  18  18  18  18  18  18  18  29  29  29  27  27  27  27  27  29  29  29  29  29  29  27  27  27  27
4252   1   48  31  32  32  25  18  18  18  18  18  18  18  29  29  29  29  29  29  29  29  27  27  27  27  27  27  27  26  26  26
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*** GB FIELD  UNIT IN C/S      , RATIO=   1.00
 ..... PAGE =      1

    XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
       I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30

4310  40    0   0   0   0   0   0   0   0   0   0   1   1   1   3   0   0   0   2   3   1   0   0   0   1   1   4   0   0   0   0
4308  39    0   0   0   0   0   0   0   0   0   0   0   0   0   6   4   9   2   7   7   3   0   0   0   0   4   0   0   0   0   0
4306  38    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   1   0   0   0   0   6   7   5   0   2   0   0   0   0   0
4304  37    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   2   2   6   1   0   0   0   0   0
4302  36    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   1   0   1   0   0   0   0   0
4300  35    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   1   0   0   1   0   0   0   2
4298  34    0   0   1   1   1   1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   2
4296  33    0   0   0   1   1   0   0   1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4294  32    0   0   0   1   1   0   0   1   1   0   0   0   0   0   0   0   0   0   0   0   2   0   0   1   0   0   0   0   0   0
4292  31    0   2   5   1   1   0   0   1   1   1   1   0   1   1   0   0   0   0   0   0   0   0   0   1   0   0   0   0   0   0
4291  30    0   2   3   1   1   2   1   1   1   1   0   0   1   1   0   0   0   0   0   0   2   5   0   3   0   0   0   0   0   0
4290  29    0   2   0   1   0   0   0   1   0   0   0   1   1   0   0   0   0   0   0   0   8   2   0   0   7   0   0   0   0   0
4289  28    0   1   1   1   1   1   0   0   3   1   0   0   1   0   0   0   0   0   3   3   4   4   0   1   0   0   0   0   0   2
4288  27    0   2   1   1   1   1   1   0   1  10  11   0   1   0   0   0   0   4   8   5  11   3   0   0   0   0   0   0   0   0
4287  26    0   1   1   1   0   1   1   1  11   3   3   2   1   0   0   0   4   4  10  10   6   0   0   0   0   0   0   0   0   1
4286  25    0   1   1   1   2   2   2   1  11   7   3   1   1   0   0   1   0   4   1   0   0   0   0   3   0   0   0   0   3   1
4285  24    0   1   1   0   0   1   2   3   3  13   5   0   2   0   0   0   7  10   3   0   0   0   0   0   0   0   0   1   4   2
4284  23    0   0   0   1   0   0   0  16   8  13  15  18  11   2   1   0   5   4   0   0   0   0   0   0   2   0   0   2   2   0
4283  22    0   1   0   1   1   1  24  22  24  17  17  16  20   7   2   0   2   2   0   0   0   0   0   0   0   0   0   2   5   0
4282  21    0   0   1   1   2  12  14  22  18  22  16  23  19  14   4   0   0   0   0   0   0   0   0   2   0   0   0   0   1   0
4281  20    0   0   0   1   1  15  33  18  13  21  26  20  20  21  10   0   1   0   0   0   0   3   2   0   0   0   0   0   1   0
4280  19    0   0   0   1   1   2   0   2  16  22  10  19  29  16   3   0   0   0   0   0   7   5   6   7   0   0   0   0   1   0
4279  18    0   0   0   1   3   0   0   0   5   6   1  10   3  13   9   1   0   0  10  10   5   9   6   4   0   0   4   0   0   0
4278  17    0   2   1   1   3  12   8   1  13   7   5   9   3   1   5   1   0   5  12  12   2   8   1   0   3   0   0   0   0   0
4277  16    0   0   1   1   5   2   8   6   8  24  12  18  10  21   2   0   1  13  17   7   9   7   1   0   0   0   2   0   0   0
4276  15    0   0   0   0   1   3  15   5   6   4  22  22  13  12   1   0   3   9   7   6   0   0   4   7   8   1   0   1   1   1
4275  14    1   2   2   3  15  29  26   6   8  27  16  15  15   4   1   0   0   0   0   7   2   1   6   0   6   6   0   1   1   1
4274  13    2   2   4   1   1  15  24  12   9  15  17  19   7   0   0   1   1   1   0   0   4   1   0   0   0   1   0   3   0   0
4273  12    1   2   2   2   2   0   6  13  10  15  16   5   1   0   0   1   1   1   0   0   4   3   0   0   0   4   1   0   0   0
4272  11    0   0   0   0   0   0   1  10  12  11  14   1   0   1   1   2   2   1   1   1   1   7   0   0   0   1   2   0   0   0
4270  10    0   0   0   1   0   0   1  10   6  11   2   0   0   1   1   3   3   2   2   2   1   1   0   0   0   1   4   2   0   1
4268   9    0   0   0   0   0   0   0   1   6   0   0   0   0   1   1   0   0   0   0   0   0   0   0   0   0   0   0   5   4   3
4266   8    0   0   0   0   0   1   1   0   0   0   0   0   0   1   1   0   0   0   0   0   0   0   0   0   0   0   0   0   6   7
4264   7    0   0   0   0   0   1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   2   1
4262   6    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4260   5    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4258   4    0   0   0   0   0   0   0   0   0   0   0   0   0   1   3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4256   3    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4254   2    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
4252   1    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0

 .... TOTAL EMISSION : READ IN=     886.5,   MODEL USED=    3545.9,  IN G/SEC
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*** POINT SOURCE DATA ***
   ..... TOTAL NUMBER =  150

 N    ID      XPUTM     YPUTM        ZP       QP        ZP      XP      YP
  1  183      732.1    4253.9     106.7  1174.17    1062.5    3.55    0.95
  2  182      732.1    4253.9     106.7  1127.57    1013.4    3.55    0.95
  3  180      732.1    4253.9      76.2   515.01     730.7    3.55    0.95
  4  181      732.1    4253.9      76.2   196.74     730.7    3.55    0.95
  5  176      733.0    4263.3      34.9     7.11      84.0    4.00    5.65
  6  171      738.0    4263.3      20.7    37.66     233.3    8.00    5.65
  7  127      762.6    4266.6      21.3     1.27       0.0   28.80    7.30
  8  125      762.8    4266.6      20.7     1.24      32.6   28.90    7.30
  9  101      762.6    4266.7      25.9     1.04       0.0   28.80    7.35
 10  108      761.5    4267.6      68.5    27.07     259.8   28.25    7.80
 11  178      738.0    4268.3      44.8    49.80      94.4    8.00    8.15
 12  174      738.0    4268.3      21.0    45.16     233.7    8.00    8.15
 13  175      738.0    4268.3      25.3    43.29     228.4    8.00    8.15
 14  179      738.0    4268.3      61.0    31.21     146.1    8.00    8.15
 15  170      738.0    4268.3      20.7    28.91     189.6    8.00    8.15
 16  172      738.0    4268.3      21.0    14.87     193.9    8.00    8.15
 17  173      738.0    4268.3      21.0    14.87     193.9    8.00    8.15
 18  177      738.0    4268.3      30.5    13.87     149.3    8.00    8.15
 19  148      736.9    4269.4      13.7   154.19       0.0    6.90    8.70
 20  131      751.9    4272.8      16.8     0.72       0.0   21.90   10.80
 21  165      737.2    4273.2      82.9    39.35     218.8    7.20   11.20
 22  146      742.5    4275.1      68.6    46.54     171.6   12.50   13.10
 23  145      742.5    4275.1      68.6     9.32     319.5   12.50   13.10
 24  144      742.5    4275.1      68.6     6.47     185.0   12.50   13.10
 25  155      743.0    4275.0      76.2     3.14     550.3   13.00   13.00
 26  113      746.4    4275.7      42.7    91.36     209.7   16.40   13.70
 27  114      746.4    4275.7      45.7    87.94     209.0   16.40   13.70
 28  110      746.4    4275.7      42.7    70.88     122.0   16.40   13.70
 29  111      746.4    4275.7      42.7    67.72     118.9   16.40   13.70
 30  112      746.4    4275.7      42.7    22.58     121.7   16.40   13.70
 31  129      746.3    4275.2      15.7     0.20      37.2   16.30   13.20
 32  153      743.0    4276.5      45.7   100.63     198.9   13.00   14.50
 33  152      743.0    4276.5      45.7    40.79     126.7   13.00   14.50
 34  151      743.0    4276.5      45.7    37.54     121.5   13.00   14.50
 35  149      743.0    4276.5      45.7    20.31     114.7   13.00   14.50
 36  150      743.0    4276.5      45.7    12.28     113.9   13.00   14.50
 37  118      745.1    4277.3     100.0    36.59     943.1   15.10   15.30
 38  119      745.1    4277.3     100.3    36.59     942.0   15.10   15.30
 39  120      745.1    4277.3     100.0    36.59     881.1   15.10   15.30
 40  122      745.1    4277.3     100.3    12.34    1185.3   15.10   15.30
 41  123      745.1    4277.3     100.3    11.33    1149.7   15.10   15.30
 42  121      745.1    4277.3     100.3     4.34     542.1   15.10   15.30
 43  130      748.5    4277.3      15.2     0.55       0.0   18.50   15.30
 44  124      748.3    4277.3       7.6     0.12       0.0   18.30   15.30
 45  166      737.2    4278.2      82.9    49.19     370.4    7.20   16.20
 46  109      747.8    4280.9      76.2     1.50       0.0   17.80   18.90
 47  160      734.2    4281.0      54.3    13.35     153.1    4.60   19.00
 48  156      745.0    4281.0      54.9   134.34     986.6   15.00   19.00
 49  157      745.0    4281.0      55.8    79.40     503.4   15.00   19.00
 50  158      745.0    4281.0      56.7    70.19     503.4   15.00   19.00
 51  159      745.0    4281.0      56.7    68.46     503.4   15.00   19.00
 52  133      753.0    4281.3      53.3    52.07      59.8   23.00   19.30
 53  134      753.0    4281.3      18.6     7.48      55.3   23.00   19.30
 54  147      736.8    4283.1      68.6    41.60     469.7    6.80   21.10
 55   15      745.8    4283.5      72.2   332.40     558.2   15.80   21.50
 56   14      745.8    4283.5      72.2   263.59     558.2   15.80   21.50
 57    8      745.8    4283.5      72.2    68.92     397.7   15.80   21.50
 58   12      745.8    4283.5      72.2    67.03     386.1   15.80   21.50
 59   11      745.8    4283.5      72.2    66.39     386.1   15.80   21.50
 60   13      745.8    4283.5      72.2    57.50     385.9   15.80   21.50
 61   10      745.8    4283.5      72.2    54.60     386.1   15.80   21.50
 62    9      745.8    4283.5      72.2    52.70     397.7   15.80   21.50
 63  154      742.5    4284.2      76.2     3.14     550.3   12.50   22.20
 64   84      746.5    4285.7      22.9   195.33     270.7   16.50   23.70
 65   83      746.5    4285.7      25.9   168.54     260.6   16.50   23.70
 66   94      746.5    4285.7      22.9     0.03       0.0   16.50   23.70
 67  167      725.0    4286.0      15.2     0.49     190.6    0.0    24.00
 68   81      745.2    4286.8      21.1     3.28      98.6   15.20   24.80
 69   40      747.2    4286.8      14.6    15.53      78.6   17.20   24.80
 70  100      748.9    4286.0       8.3     0.58      75.1   18.90   24.00
 71   39      747.0    4287.7      60.0     0.0      300.0   17.00   25.70
 72   91      747.0    4287.5      20.0     5.55      40.0   17.00   25.50
 73   92      747.0    4287.0      20.0     5.55      40.0   17.00   25.00
 74   38      747.0    4287.5      61.0     4.55      88.0   17.00   25.50
 75   41      747.8    4287.8      14.6     2.24      70.0   17.80   25.80
 76  168      736.5     4290.5       45.7      1.35     101.5    6.50   28.50
 77  169      741.8     4290.5       71.6    135.78     720.8   11.80   28.50
 78    7      755.5     4290.1        9.1      2.65     768.8   25.25   28.10
 79   97      753.7     4302.9       45.7     74.10     210.4   23.70   35.45
 80   36      754.5     4302.5       54.0     63.52     261.0   24.50   35.25
 81   35      754.5     4302.5       24.1     15.07     201.5   24.50   35.25
 82   37      754.5     4302.5       32.7     11.51     190.6   24.50   35.25
 83   33      754.5     4302.5       54.9      9.38     216.8   24.50   35.25
 84   28      754.5     4302.5       33.5      6.90     195.6   24.50   35.25
 85   34      754.5     4302.5       16.8      6.36     176.8   24.50   35.25
 86   29      754.5     4302.5       28.3      6.30     261.8   24.50   35.25
 87   30      754.5     4302.5       28.3      6.30     234.7   24.50   35.25
 88   32      754.5     4302.5       30.8      6.18     238.2   24.50   35.25
 89   31      754.5     4302.5       27.1      5.61     183.1   24.50   35.25
 90   46      754.0     4303.0       95.1     96.63     704.6   24.00   35.50
 91   60      754.0     4303.0      106.7     80.78     858.9   24.00   35.50
 92   69      754.0     4303.0       63.1     46.20     334.7   24.00   35.50
 93   70      754.0     4303.0       63.1     46.20     334.7   24.00   35.50
 94   73      754.0     4303.0       40.2     46.20     324.9   24.00   35.50
 95   74      754.0     4303.0       40.2     46.20     324.9   24.00   35.50
 96   59      754.0     4303.0       61.0     43.01     632.1   24.00   35.50
 97   75      754.0     4303.0       42.0     42.72     325.0   24.00   35.50
 98   76      754.0     4303.0       42.0     42.72     325.0   24.00   35.50
 99   44      754.0     4303.0       56.4     42.63     367.6   24.00   35.50
100   71      754.0     4303.0       63.1     31.38     270.7   24.00   35.50
101   72      754.0     4303.0       63.1     31.38     270.7   24.00   35.50
102   77      754.0     4303.0       29.8     30.23     163.0   24.00   35.50
103   50      754.0     4303.0       45.7     29.37     605.7   24.00   35.50
104   43      754.0     4303.0       45.7     26.32     304.0   24.00   35.50
105   49      754.0     4303.0       30.5     18.96     495.3   24.00   35.50
106   56      754.0     4303.0       45.7     14.79     391.4   24.00   35.50
107   47      754.0     4303.0       45.7     12.80     325.9   24.00   35.50
108   66      754.0     4303.0       45.7     12.66     371.7   24.00   35.50
109   51      754.0     4303.0       45.7     11.77     301.0   24.00   35.50
110   52      754.0     4303.0       45.7     11.77     301.0   24.00   35.50
111   57      754.0     4303.0       45.7     11.54     335.4   24.00   35.50
112   64      754.0     4303.0       61.0      9.98     473.7   24.00   35.50
113   65      754.0     4303.0       61.0      9.98     473.7   24.00   35.50
114   68      754.0     4303.0       21.3      9.26     293.7   24.00   35.50
115   48      754.0     4303.0       45.7      9.15     239.5   24.00   35.50
116   54      754.0     4303.0       45.7      8.72     462.9   24.00   35.50
117   45      754.0     4303.0       45.7      8.66     150.0   24.00   35.50
118   55      754.0     4303.0       45.7      7.97     314.9   24.00   35.50
119   58      754.0     4303.0       45.7      5.98     237.8   24.00   35.50
120   53      754.0     4303.0       45.7      5.67     235.5   24.00   35.50
121   61      754.0     4303.0       45.7      5.38     282.9   24.00   35.50
122   62      754.0     4303.0       45.7      5.38     282.9   24.00   35.50
123   63      754.0     4303.0       45.7      5.38     278.2   24.00   35.50
124   67      754.0     4303.0       45.7      4.57     118.2   24.00   35.50
125    6      748.7     4305.4      106.7   1720.91     779.2   18.70   36.70
126    4      748.7     4305.4       76.2    693.51     585.3   18.70   36.70
127    5      748.7     4305.4       76.2    278.66     433.4   18.70   36.70
128  142      740.4     4306.7      182.9   1681.87    1210.0   10.40   37.35
129  143      740.4     4306.7      183.0   1640.59    1210.0   10.40   37.35
130   93      748.1     4306.7       13.7      0.06       0.0   18.10   37.35
131   26      752.4     4306.6       51.5     91.94     793.1   22.40   37.30
132   16      752.4     4306.6       48.5     51.72     277.0   22.40   37.30
133   20      752.4     4306.6       48.8     48.39     383.6   22.40   37.30
134   25      752.4     4306.6       23.8     42.00     145.3   22.40   37.30
135   18      752.4     4306.6       48.5     36.99     240.8   22.40   37.30
136   19      752.4     4306.6       48.5     36.99     240.8   22.40   37.30
137   17      752.4     4306.6       48.5     25.86     195.9   22.40   37.30
138   27      752.4     4306.6       18.4     13.20     116.4   22.40   37.30
139   24      752.4     4306.6       44.2     12.66      50.0   22.40   37.30
140   21      752.4     4306.6       33.5      5.24     311.2   22.40   37.30
141   23      752.4     4306.6       33.5      4.63     311.2   22.40   37.30
142   22      752.4     4306.6       33.5      4.55     311.2   22.40   37.30
143   42      746.0     4307.8       51.8      5.72     385.0   16.00   37.90
144   87      747.6     4307.8       58.5    242.19     533.3   17.60   37.90
145   80      747.6     4307.8       34.1    149.47     231.3   17.60   37.90
146   86      747.6     4307.8       58.3     82.04     208.5   17.60   37.90
147   79      747.6     4307.8       32.0     56.93     100.0   17.60   37.90
148   85      747.6     4307.8       76.2     51.58     277.4   17.60   37.90
149   78      747.6     4307.8       25.9      7.05      73.8   17.60   37.90
150   88      744.1     4309.7       16.8      3.34      57.8   14.10   38.85

   .... TOTAL EMISSION : READ IN=   30286.6,   MODEL USED=   14378.0,   IN G/SEC
```

```
... IYR,IMO,IDAY,IHR = 75/ 2/ 1/ 1/ ......
  ***** RAMS DATA *****
 IS     1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25
 UU   5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0
 DD    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 T1    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 T2    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 CC    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 RA    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.

RH=  1.00  GRID Z(K)=     0.   20.   40.   60.   80.  100.  125.  150.  175.  200.  225.  250.  275.  300.
                UZF(K)=  1.00  1.11  1.23  1.31  1.37  1.41  1.46  1.49  1.49  1.49  1.49  1.49  1.49  1.49
                VZF(K)=  1.00  1.11  1.23  1.31  1.37  1.41  1.46  1.49  1.49  1.49  1.49  1.49  1.49  1.49
                AKF(K)=  1.92  2.77  4.26  5.51  6.54  7.47  8.26  8.83  9.22  9.45  9.56  9.56  9.47  9.50
            KZ(J=JM/2)=   2.4   2.4   2.5   7.3   4.8   6.6   5.8   3.5   2.4   2.1   1.9   2.0   1.6   1.9   2.2
DT= 120.0     PARM(N)=       5.00        0.0          0.0          0.50      300.00    3545.86   14378.01        0.0         0.0       318.23
  UO=    0.449  PHZ=    0.888  HFZ=    3.901  RIB=    0.0

** VERTICAL PROFILE OF * C1 AT I= 15; J= 19**

     XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
        I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30
  Z   K
 300  14     2   7   9   8   7  12  37  34  59 117 171 133  62  21  51 593 203 234 363 149  47  31  62 108 215  47   3   2   4   6
 275  13     2   7   9   8   7  12  37  34  60 117 171 133  62  22  53 607 206 234 367 149  47  31  62 108 214  47   3   2   5   6
 250  12     2   8   9   8   7  13  39  36  61 118 172 134  63  23  54 638 213 235 365 149  47  31  62 108 213  47   3   2   5   6
 225  11     2   8  10   8   8  14  40  37  62 120 173 135  65  24  55 654 221 236 364 148  48  31  62 107 213  47   3   2   5   7
 200  10     2   8  10   9   8  15  43  40  64 122 175 137  67  25  53 614 229 237 362 148  48  31  61 107 212  47   3   2   6   7
 175   9     2   8  10   9   8  17  45  43  67 125 178 139  70  28  50 538 235 237 360 146  48  32  61 106 212  47   3   3   7   7
 150   8     3   9  11  10   9  19  48  47  71 128 181 143  73  31  45 439 241 238 357 145  48  32  60 105 211  46   3   4   9   8
 125   7     3  10  12  11  10  23  52  53  76 133 186 147  78  35  41 343 246 237 354 143  48  32  59 103 210  46   3   4  10   8
 100   6     3  10  13  12  11  28  60  61  82 140 192 154  84  40  38 262 248 236 350 140  48  32  59 102 209  45   3   5  11   9
  80   5     3  11  13  13  12  34  71  69  88 147 199 160  91  47  38 208 249 235 345 137  49  33  58 101 208  45   3   6  13   9
  60   4     4  12  14  14  14  42  87  81  97 156 209 169 100  55  40 164 248 232 340 134  49  34  59 103 207  44   3   8  16   9
  40   3     4  12  15  16  16  54 110  94 106 166 222 179 109  66  45 130 246 228 332 129  50  36  60 104 204  44   3   9  18  10
  20   2     4  13  16  16  16  53 102  92 105 165 217 178 109  65  42 106 241 221 320 124  49  35  59 101 199  43   3  10  21  10
   0   1     4  12  16  16  16  52 101  91 104 163 213 176 109  64  42 105 237 213 307 119  48  34  56  99 193  42   3  10  20  10

     YUTM=4262426442664268427042724273427442754276427742784279428042814282428342844285428642874288428942904291429242944296429843C0
        J=   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35
  Z   K
 300  14   170 169 159 148 140 132 125 119 112 106  98  86  70  51  34   6   4   5   5   6   6   6   7   7   7   7   7   6   6   5
 275  13   171 169 160 148 140 133 126 120 113 107  99  87  71  53  36   7   4   5   5   6   6   6   7   7   7   7   7   6   6   5
 250  12   171 169 160 149 141 133 126 120 113 107  99  88  71  54  40   7   4   5   5   6   6   7   7   7   7   7   7   6   6   5
 225  11   171 169 160 149 141 133 126 120 112 106  99  88  71  55  45   8   4   5   5   6   6   7   7   7   7   7   7   7   6   6
 200  10   170 170 161 149 141 133 125 119 111 105  97  88  70  53  42   8   5   5   5   6   6   7   7   7   7   8   7   7   6   6
 175   9   170 170 161 149 140 132 125 117 109 103  95  84  66  50  37   8   5   5   5   6   6   7   7   8   8   8   8   7   7   7
 150   8   170 170 161 149 140 132 124 117 107 100  92  80  63  45  30   7   5   5   6   6   7   7   7   8   8   8   8   8   7   8
 125   7   169 170 161 149 139 130 123 116 106  98  89  76  59  41  26   7   5   5   6   6   7   7   8   8   8   8   9   8   8   8
 100   6   168 170 162 149 138 129 121 115 104  96  87  74  57  38  23   7   6   5   6   6   7   8   8   9   9   9   9   9   9   9
  80   5   167 170 162 149 138 127 119 113 103  96  87  74  56  38  23   8   6   6   6   7   7   8   9   9   9   9   9   9   9  10
  60   4   165 170 163 149 137 126 117 111 102  96  89  77  57  40  25  10   7   6   6   7   8   8   9  10  10   9   9  10   9  11
  40   3   164 170 164 150 138 125 115 110 103  98  93  82  60  45  29  12   9   6   6   7   8   9  10  11  11  10  10  10  10  12
  20   2   160 168 163 149 136 122 113 108 101  96  90  79  57  42  27  11   9   6   6   7   8   9  10  11  11  10  10  11  10  12
   0   1   156 167 163 149 136 121 112 107 100  95  89  77  57  42  26  11   8   6   6   7   8   9   9  11  11  10  10  11  10  12
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*** CC FIELD FOR LAYER K=    1 , RATIO=    1.00
 ..... PAGE =      1

   XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
      I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30

4310  40   0   0   1   1   0   0   0   0   0   0   2   2   4   5   6   0   0   1   2   0   0   0   2   3   0  10   0   0   0   0
4308  39   1   1   1   1   0   0   0   0   0   1   3   3   6  31  27  27   8  26  32  14   0   0   1   4  12  13   1   2   0   0
4306  38   1   1   1   1   0   1   1   1   1   1   0   2   4  25  22  33   9  39  26  12  15  14   7   1  10   7   1   2   0   0
4304  37   1   1   1   1   0   0   1   1   0   0   9   1   3  15  14  21   7  87  19   8  15  25  82  21  18   9   1   1   1   1
4302  36   1   1   1   1   0   1   0   0   1   3  79   4   2  10   9  13   9 129   8   5  10  23 123  20  13   5   0   1   0   0
4300  35   1   0   0   0   0   0   0   0   0  13 165  13   2   7   7   9  12 141  41   3   7  20 121  30  19   7   0   1   2   6
4298  34   0   2   4   3   1   3   0   0   3  25 219  24   2   4   5   7  16 142 141  10   7  19 102  49 135   9   0   1   2  12
4296  33   1   4   6   7   6   5   0   2   3  42 240  38   5   4   5   6  19 139 224  21   2  17  82  54 218  11   0   1   2  10
4294  32   1   3   1   8   8   4   0   4   7  46 223  45   5   2   3   6  21 132 262  32  15  15  66  61 230  14   1   1   2   7
4292  31   3   6  11   8   8   3   1   7  12  48 193  47   9   5   4   5  20 120 255  38  13  12  53  61 209  16   1   1   2   5
4291  30   3   9  18   9   8   5   3   8  14  50 175  47  11   8   5   4  19 111 248  41  12  18  44  64 193  17   1   1   2   5
4290  29   2  11  18   9   8   7   4   8  14  49 156  45  11   8   5   4  18 104 235  41  23  26  51  63 189  17   1   1   2   4
4289  28   3  11  14   9   8   6   3   9  15  44 134  42  12   7   4   3  18  96 229  48  31  28  58  59 178  17   1   1   2   6
4288  27   3  10  14   9   9   7   4   8  15  49 125  40  14   6   4   3  17  94 223  56  36  32  46  55 154  16   1   1   1   8
4287  26   3  11  13   9   8   7   6   8  20  55 118  44  14   5   4   3  20  95 216  71  48  30  37  47 135  15   1   1   1   7
4286  25   4  11  12   9   8   8   7   9  33  52 101  50  15   5   3   4  23 107 196  77  47  22  30  47 117  15   1   0   2   8
4285  24   4  11  12   9   9  10  10  10  39  56  87  46  14   4   2   7  24 124 172  64  37  19  25  46 100  13   1   1   9  10
4284  23   3  11  11   9   8  10   9  17  34  62  83  58  19   4   2   7  45 118 146  53  30  15  20  39  90  12   1   4  13  12
4283  22   3  10  10   9   8   8  18  37  44  66  88  77  36   9   5   9 146 105 119  45  25  13  17  32  78  13   1   9  16  10
4282  21   2   9  11  10  10  13  42  57  65  75  89  88  56  20   3  12 177  91  97  38  21  10  13  30  64  13   2  11  21   8
4281  20   2   9  11  11  12  33  62  70  71  85  93  98  68  39  23  43 177  77  79  33  16  11  12  26  52  12   2   9  18   6
4280  19   2   8  10  11  11  46  90  77  74  93 103 102  81  56  37  88 165  66  61  26  18  16  18  29  42  11   1   8  16   5
4279  18   2   6   9  11  12  37  73  66  77  97  93 103  98  66  49 138 150  55  55  28  27  24  29  48  32  10   5   7  14   4
4278  17   2   7   9  11  18  35  60  53  70  82  76  93  81  65  66 181 138  51  57  41  27  34  33  65  30   7   9   5  11   4
4277  16   2   8   9  12  23  44  59  50  74  81  71  98  71  61  73 210 129  59  65  49  30  40  28  60  24   6   9   4   9   4
4276  15   3   7   8  11  22  36  60  57  72  91  80  95  74  76  74 227 126  71  72  48  35  41  26  57  25   4  10   6  10   5
4275  14   2   7   8  10  27  46  72  61  69  86  93 102  82  92  74 233 115  70  64  48  20  32  32  56  34  11   9   8  12   6
4274  13   5   9  12  13  40  75  92  67  70 101  97 104  95 143  75 236 123  59  50  47  28  28  34  46  34  17   8  11  12   7
4273  12   8  12  15  14  36  81 103  77  73 101 101 113 102 158  74 235 216  55  41  38  32  25  27  38  25  17   6  13  10   6
4272  11   7  12  14  13  31  64  98  87  80 100 115 103  96 157  77 233 266  53  34  30  31  36  21  31  19  20   6   8  10   5
4270  10   4   8   9  12  21  44  30 102  89 136 104  76  80 131  78 215 230  58  34  30  27  35  18  24  15  16  10   9   5   6
4268   9   3   5   6   9  15  35 267  92  55  87  76  57  66 105  76 177 189  49  26  23  20  24  14  19  12  13  18  23  12   8
4266   8   2   4   5   7  13  34 222  76 134  65  55  43  52  84  69 138 142  38  19  16  14  16  11  15  10   9  11  22  29  28
4264   7   1   4   5   7  10  32 135  66 175  53  40  32  41  66  57 103 105  31  14  12  10  12   9  11   8   6   8  14  35  29
4262   6   1   4   5   6  11  27  91  55 137  43  29  24  31  49  44  72  76  24  11   9   7   8   7   8   6   5   6  10  27  19
4260   5   1   3   4   4  10  23  66  45 116  33  20  16  23  32  26  48  53  18   8   6   6   6   5   6   4   4   5   7  10  13
4258   4   1   2   3   4   8  17  46  36  98  26  17  14  16  29  31  29  35  12   5   4   4   4   3   4   3   3   4   6  15  10
4256   3   1   2   2   3   6  13  33  28  76  20  12   9  10  19  21  17  21   8   3   2   3   3   2   3   2   2   3   5  13   8
4254   2   0   1   1   2   4   9  22  21  55  15   7   5   6  11  12   9  12   5   2   1   2   2   2   2   2   2   2   4  10   6
4252   1   0   1   1   2   3   6  15  16  40  11   5   3   4   7   7   5   7   3   1   1   1   1   1   1   1   1   1   3   7   4

** 2HR STATION SO2 ** MO,DAY,HR= 2/ 1/ 24,  NTS=  30,   ... SPATIAL AVERAGE... CAL=   50 OBS=    0
 IS     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    21    22    23    24    25
 XS  14.2  12.5  17.6  17.3  13.7   8.7  10.2  18.4  25.4  17.2   8.8   4.5   7.7  14.3  26.1  28.9  27.8  13.1   2.4  -1.3   3.7  11.6  36.2  19.3-13.9
 YS  17.9  24.0  20.5  15.3  14.5  15.6  20.6  29.1  17.9  10.8  10.5  18.9  27.8  32.7  22.9  29.1  10.8   5.6   9.3  23.9  35.2  48.6  24.4  -7.7  20.2
CAL    51    15    91    75    77    76    84   231    13   111    37    12    10     5     5     3    10    44     9     4     1     3     7     1     2
OBS     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
```

```
... IYR,IMO,IDAY,IHR = 75/ 2/ 1/ 2/ .......
  ***** RAMS DATA *****
 IS     1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25
 UU   5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0  5.0
 DD   15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.
 T1    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 T2    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 CC    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
 RA    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.

RH=  1.00  GRID Z(K)=      0.   20.   40.   60.   80.  100.  125.  150.  175.  200.  225.  250.  275.  300.
                UZF(K)=   1.00  1.11  1.23  1.31  1.37  1.41  1.46  1.49  1.49  1.49  1.49  1.49  1.49  1.49
                VZF(K)=   1.00  1.11  1.23  1.31  1.37  1.41  1.46  1.49  1.49  1.49  1.49  1.49  1.49  1.49
                AKF(K)=   1.92  2.77  4.26  5.51  6.54  7.47  8.26  8.83  9.22  9.45  9.56  9.56  9.47  9.50
            KZ(J=JM/2)=    2.4   2.4   2.5   7.3   4.8   6.6   5.8   3.5   2.4   2.1   1.9   2.0   1.6   1.9   2.2
DT= 120.0     PARM(N)=        5.00      15.00       0.0        0.50      300.00    3545.86   14378.01       0.0        0.0      318.23
  U0=    0.449  PHZ=    0.888  HFZ=    3.901  RIB=    0.0

** VERTICAL PROFILE OF * C1 AT I= 15; J= 19**

     XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
       I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30
  Z    K
 300  14    9  13  20  46 104 160 124  68  75 122 172 214 242 259 356 605  51  88 135 103  53   6   1   2   0   1   2   4   5   0
 275  13    9  14  20  46 104 161 125  68  76 122 172 214 242 259 361 615  53  87 135 103  53   7   1   2   0   1   2   4   5   0
 250  12    9  14  20  46 104 161 126  70  77 123 173 215 243 260 366 642  55  86 135 104  53   7   1   2   1   1   2   4   5   0
 225  11    9  14  20  46 104 162 129  72  78 125 174 216 244 260 366 660  60  85 135 104  53   7   2   2   1   1   3   5   5   0
 200  10   10  14  20  46 104 164 132  74  81 127 176 218 246 260 356 635  69  84 136 105  54   8   3   2   1   1   3   5   6   0
 175   9   10  15  21  46 104 167 135  78  84 130 179 221 248 260 341 577  84  82 136 106  54   8   4   2   1   1   3   6   7   0
 150   8   10  15  21  46 104 170 140  83  88 134 183 224 251 260 320 501 102  80 137 107  55   9   6   2   1   1   3   7   8   0
 125   7   11  16  21  47 104 174 146  90  93 139 188 229 255 261 298 427 120  78 138 108  56  11  10   3   1   2   3   8   9   0
 100   6   11  16  22  47 105 180 156  98  99 146 195 235 261 263 279 363 135  76 138 109  58  13  16   4   2   2   4   9  11   0
  80   5   11  17  22  47 105 188 169 108 106 153 202 242 267 267 267 321 145  75 139 110  59  15  19   4   2   2   4  11  13   0
  60   4   12  18  23  48 106 198 187 120 115 163 213 251 276 273 258 287 153  74 139 111  61  17  18   6   2   3   4  13  15   0
  40   3   12  18  24  48 107 211 211 133 125 174 226 262 285 281 254 261 159  73 138 113  65  20  18   8   2   4   4  15  17   0
  20   2   12  18  23  47 105 210 207 134 124 173 223 261 285 280 248 244 161  71 138 114  65  21  16   9   2   5   4  16  19   0
   0   1   12  18  23  45 102 209 210 136 124 171 220 259 284 280 250 246 160  68 136 115  66  22  16   9   2   5   4  16  19   0

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       J=   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35
  Z    K
 300  14  137 146 163 197 255 343 413 492 621 561 569 640 455 356 288 181 185 220 250 278 302 320 330 331 326 312 271 191 105  35
 275  13  137 146 164 198 255 343 411 485 576 546 567 617 449 361 295 184 184 220 250 278 301 310 328 330 324 311 270 190 105  35
 250  12  138 147 165 199 256 342 406 472 539 533 563 606 446 366 313 191 183 219 249 276 290 317 326 327 321 308 266 187 104  37
 225  11  139 149 167 201 258 341 399 457 510 520 557 614 446 366 330 199 182 218 247 274 296 313 322 323 316 303 261 182 102  39
 200  10  141 151 170 205 261 340 392 443 487 536 545 616 440 356 319 197 183 217 245 271 293 308 317 317 310 296 253 176  99  41
 175   9  143 154 173 208 264 339 386 431 469 492 522 555 414 341 297 193 185 216 242 267 288 303 310 310 303 288 244 168  95  42
 150   8  145 157 177 213 268 339 380 420 454 476 496 498 387 320 269 188 187 214 240 263 283 297 304 303 295 279 234 159  90  43
 125   7  148 161 181 218 273 340 376 411 441 461 471 455 362 298 246 185 189 213 237 259 278 291 297 295 286 269 224 150  85  42
 100   6  151 165 186 223 277 340 372 404 431 447 449 422 341 279 231 183 191 211 234 255 272 284 289 287 277 260 213 141  80  42
  80   5  154 169 191 228 282 341 370 400 425 438 435 402 327 267 222 183 191 211 233 252 268 279 284 281 271 253 205 134  76  41
  60   4  158 174 196 234 287 342 369 397 421 431 424 388 316 258 216 183 192 210 231 249 264 274 278 275 264 246 198 128  72  40
  40   3  162 179 202 240 293 345 369 397 419 427 419 380 310 254 215 185 194 210 229 246 260 270 273 270 259 240 191 122  69  39
  20   2  166 185 206 245 298 347 371 399 419 425 412 370 303 248 211 185 194 209 227 243 256 265 268 265 254 235 186 118  66  38
   0   1  169 189 210 249 302 351 376 404 424 431 417 373 305 250 212 186 195 209 227 242 254 263 266 263 252 232 185 117  65  38
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    XUTM=  725  727  729  731  733  735  736  737  738  739  740  741  742  743  744  745  746  747  748  749  750  751  752  753  754  755  757  759  761  763
       I=    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29   30

4310  40     0    0    1    1    0    0    0    0    0    1    3    2    4    5    4    0    0    2    2    1    0    1    3    2    2    9    0    0    0    0
4308  39     1    1    1    1    0    1    1    1    1    2    4    4   13   36   29   27   10   28   33    7    0    0    1    8   15   12    1    2    0    0
4306  38     1    1    1    1    0    1    1    1    0    0    4    5   15   33   23   24   10   67   19    8   12    9   15    3   23    5    1    2    0    0
4304  37     1    1    1    1    1    1    0    0    2   13    2    6   14   21   16   33   63   57    5    8   29   67   56   20   17    6    0    2    0    0
4302  36     1    1    1    1    0    1    1    8   42   57   10    7   12   17   22   55   87   32    3   19   54   86   39    7   15    2    0    1    0    0
4300  35     1    0    0    0    0    1   11   48   98   79   31    7   11   18   33   75  103   49    8   31   64   75   61   73   15    5    0    1    3    5
4298  34     1    3    5    3    2   10   37   92  133   83   54    7   11   23   53  111  148   99   24   41   66   83  127  147   18    3    0    1    4   12
4296  33     2    6    8    8    9   26   70  128  136   93   72   10   17   39   87  158  193  127   48   46   66  107  162  125   35    1    0    2    4    9
4294  32     3    4    2   11   15   40   93  137  126   91   82   14   26   62  123  190  199  134   74   56   91  123  159   95   50    1    1    2    4    6
4292  31     5    9   14   12   20   51  104  133  117   98   90   23   43   88  146  195  188  137   95   63   96  125  141   78   57    2    1    3    4    4
4291  30     6   12   21   13   23   59  108  128  115  103   93   28   52   99  154  192  180  139  105   67   99  132  126   76   58    2    1    3    4    4
4290  29     6   15   22   14   25   65  107  122  111  137   94   33   60  106  157  186  172  142  113   70  115  137  128   74   63    2    2    3    4    3
4289  28     8   16   18   15   28   67  104  117  110  106   94   39   67  108  155  180  167  145  121   78  124  136  130   71   74    2    2    3    4    5
4288  27     8   16   18   16   30   69  103  112  111  115   99   44   73  110  153  174  161  152  135   88  129  134  113   71   67    2    2    3    4    7
4287  26     8   17   18   16   30   69  101  110  118  129  114   54   77  110  150  168  167  165  156  105  139  123  101   69   63    2    1    2    3    7
4286  25    10   17   17   17   32   71  101  113  133  131  119   64   78  110  148  169  180  185  173  113  132  110   93   73   60    2    1    2    5    7
4285  24    10   18   17   17   33   72  102  114  144  141  119   63   78  109  146  169  186  208  169  102  119  100   90   77   56    2    1    4   13    9
4284  23    10   18   16   17   32   71   97  124  144  154  127   78   84  113  144  169  215  216  166   93  109   94   87   74   55    2    2    7   17   11
4283  22    10   17   16   18   32   69  114  146  156  165  144  101  101  117  147  193  317  201  154   88  102   89   85   71   57    3    3   13   20    8
4282  21     9   17   16   19   34   80  143  168  179  175  153  113  119  127  153  225  343  177  146   84   97   94   83   72   54    4    4   16   24    5
4281  20    10   17   17   20   38  106  166  182  187  188  161  133  131  150  194  278  326  156  140   81   92   84   79   71   51    5    4   15   21    3
4280  19    10   16   16   21   40  125  197  189  193  197  173  142  149  178  235  327  288  142  132   76   93   90   95   71   48    6    3   15   20    2
4279  18    10   15   16   22   44  119  181  190  199  193  163  149  169  207  293  363  242  133  131   83  103  107  132   75   44    6    9   14   18    2
4278  17    10   16   16   23   51  121  168  170  191  178  145  143  160  227  356  369  201  133  141  103  106  123  132   72   43    6   13   12   14    2
4277  16    11   17   17   26   60  131  167  167  193  172  136  143  169  279  388  351  170  147  152  109  111  129  114   63   41    6   13   10   12    2
4276  15    11   16   17   26   61  125  175  169  189  177  145  157  191  328  391  325  155  164  159  108  117  126  101   64   40    5   14   12   13    3
4275  14    11   16   17   28   71  144  187  166  183  171  159  178  246  346  380  293  139  169  149  138  110  115  100   71   50   11   14   14   15    4
4274  13    14   19   22   33   90  177  202  166  182  184  168  217  338  337  363  267  149  158  131  107  107  109   97   65   51   17   12   17   15    4
4273  12    17   23   26   37   90  186  209  172  182  184  163  253  352  319  342  275  244  137  115   98  110  100   84   50   42   18   11   20   13    3
4272  11    17   23   26   38   90  179  206  177  188  186  210  263  339  309  330  297  281  102  101   91  109  105   72   53   34   20   10   15   12    3
4270  10    14   20   24   40   82  133  116  224  180  201  213  251  305  297  313  304  236   78   93   90  102   94   58   44   25   19   24   14    9    4
4268   9    13   17   22   40   79  169  390  123  190  188  197  237  274  283  294  277  178   58   81   79   87   74   48   35   18   17   25   29   14    6
4266   8    12   17   23   41   81  184  351  199  166  167  182  219  248  268  271  240  131   46   73   69   73   59   40   28   14   14   20   29   35   24
4264   7    12   17   24   41   84  186  292  223  142  155  169  200  228  251  246  205  100   41   61   59   62   48   32   21   11   12   17   27   41   22
4262   6    11   18   24   44   96  181  241  174  133  144  157  185  214  234  220  173   70   39   53   51   57   39   26   16    9   12   17   26   31   12
4260   5    11   17   24   45   87  171  203  153  125  132  144  172  199  208  188  145   65   37   46   44   43   32   21   13    0   12   17   24   23    6
4258   4    11   16   23   44   87  157  171  134  119  119  139  165  196  199  174  116   54   33   38   36   35   26   17   11    9   12   16   22   19    4
4256   3    10   15   23   44   85  143  144  116  114  134  130  153  173  177  145   90   45   29   31   29   29   21   14   11   10   12   16   20   16    3
4254   2    10   14   22   43   82  128  122  104  108   99  121  141  158  151  114   69   36   24   25   22   23   17   12   10   10   12   15   18   14    3
4252   1     9   13   22   42   77  114  136   94  100   91  112  133  141  128   91   53   29   20   21   19   18   14   10    9    9   11   14   15   12    2

** 2HR STATION SO2 ** MO,DAY,HR= 2/ 1/ 3/,  NTS=  40,   ... SPATIAL AVERAGE... CAL=  115 OBS=    0
 IS     1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25
 XS  14.2 12.5 17.6 17.3 13.7  8.7 10.2 18.4 25.4 17.2  8.8  4.5  7.7 14.3 26.1 28.9 27.8 13.1  2.4 -1.0  3.7 11.6 26.2 19.3-13.8
 YS  17.9 24.0 20.5 15.3 14.5 15.6 20.6 29.1 17.3 10.8 10.5 18.9 27.8 32.7 32.9 28.1 10.8  5.6  9.3 23.9 35.2 48.6 24.4 -7.7 20.2
CAL   249   79  174  154  342  193  159  112   11  159  187   30  117   72    1    4   16  228   23   10    1    3    7   18    0
OBS     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
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... IYR,IMO,IDAY,IHR = 75/ 2/ 1/ 3/ .......
  ***** RAMS DATA *****
IS      1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    21    22    23    24    25
UU    5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0
DD    30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.
T1     0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
T2     0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
CC     0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
RA     0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.

RH=  1.00  GRID Z(K)=       0.    20.    40.    60.    80.   100.   125.   150.   175.   200.   225.   250.   275.   300.
                UZF(K)=   1.00   1.11   1.23   1.31   1.37   1.41   1.46   1.49   1.49   1.49   1.49   1.49   1.49   1.49
                VZF(K)=   1.00   1.11   1.23   1.31   1.37   1.41   1.46   1.49   1.49   1.49   1.49   1.49   1.49   1.49
                AKF(K)=   1.92   2.77   4.26   5.51   6.54   7.47   8.26   8.83   9.22   9.45   9.56   9.56   9.47   9.50
             KZ(J=JM/2)=   2.4    2.4    2.5    7.3    4.8    5.6    5.8    3.5    2.4    2.1    1.9    2.0    1.6    1.9    2.2
DT= 150.0     PARM(N)=         5.00       30.00         0.0          0.50      300.00     3545.86   14378.01        0.0          0.0       318.23
  U0=    0.449  PHZ=    0.888  HFZ=    3.901  RIB=    0.0

** VERTICAL PROFILE OF * C1 AT I= 15; J= 19**

     XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
       I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30
  Z    K
 300  14   76  99 101  79 103 217 217 162 119  96 101 134 194 310 440 206   8   1   2   3   3   3   2   1   2   2   3   3   1   0
 275  13   76  99 101  79 103 218 218 162 119  96 101 135 194 311 443 211   8   1   2   3   3   3   2   1   2   2   3   3   1   0
 250  12   76  99 101  79 104 219 219 163 121  97 102 136 195 311 452 222   9   1   2   3   3   3   3   2   2   2   3   4   2   0
 225  11   76 100 101  80 104 220 221 165 122  99 104 137 196 311 455 230   9   2   2   3   3   3   3   2   2   2   3   4   2   0
 200  10   76 100 101  80 104 222 224 168 125 102 106 140 198 308 439 219   9   2   2   3   3   4   3   2   2   2   3   5   2   0
 175   9   76 100 102  81 105 225 228 172 128 105 109 142 200 303 410 194   9   2   2   3   3   4   4   2   2   3   4   6   3   0
 150   8   76 100 102  81 106 228 234 177 133 109 113 146 202 297 372 162   8   3   2   3   4   6   6   2   2   3   4   7   3   0
 125   7   76 100 103  82 106 233 241 184 139 115 119 151 206 291 334 133   7   3   3   3   4   7   8   3   2   3   5   8   4   0
 100   6   75 100 104  84 108 240 252 193 146 122 126 158 210 286 301 108   7   4   3   3   5  10  11   3   3   4   6   9   5   0
  80   5   75 100 105  85 110 248 265 202 154 130 134 165 215 284 279  93   7   5   3   4   6  12  14   4   3   5   6  11   6   0
  60   4   75 101 106  87 112 260 284 215 164 140 145 174 223 284 262  81   7   5   3   4   7  13  15   5   3   5   7  13   7   0
  40   3   75 101 107  89 115 275 309 229 175 151 159 184 230 287 250  72   7   6   3   5   9  16  16   6   4   6   8  15   9   0
  20   2   74 100 107  89 113 272 303 229 177 152 157 184 231 283 240  67   6   6   3   5   9  16  16   7   4   7   8  17  10   0
   0   1   72  98 107  89 111 269 304 231 178 152 156 183 230 283 241  69   6   6   3   4   9  16  16   7   4   7   8  17  10   0

     YUTM=426242644266426842704272427342744275427642774278427942804281428242834284428542864287428842894290429142924294429642984300
       J=   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35
  Z    K
 300  14   14  16  20  33  52  52  20  17  97  47 138 340 341 440 407 147 109 102 110 115 113 103  89  77  73  82 138 302 487 457
 275  13   14  16  21  33  53  54  21  15  79  45 137 325 339 443 424 152 111 102 110 115 113 103  89  77  73  82 137 299 481 455
 250  12   14  16  21  34  55  60  26  13  48  44 136 319 337 452 471 164 117 103 110 115 112 103  89  77  72  81 134 289 465 446
 225  11   14  16  21  35  59  69  34  12  33  42 135 324 333 455 514 181 128 104 110 115 112 103  89  77  72  79 128 275 439 427
 200  10   14  16  22  37  64  83  48  12  24  40 131 324 324 439 495 193 146 106 111 115 112 103  89  77  71  77 121 256 406 395
 175   9   15  17  23  39  70 101  72  14  18  38 122 284 307 410 444 207 175 110 111 115 112 103  89  77  70  74 113 235 366 355
 150   8   15  17  23  41  77 121 109  17  14  35 112 246 287 372 382 221 218 116 111 115 112 103  89  76  69  72 105 212 325 313
 125   7   15  18  24  44  94 141 165  22  11  33 103 216 266 334 334 235 276 125 111 115 112 102  89  76  68  69  96 190 285 272
 100   6   15  18  26  47  91 154 184  25  10  30  95 193 247 301 300 238 273 126 112 115 111 102  89  75  66  66  87 168 248 234
  80   5   15  19  27  49  95 155 161  23   9  29  90 190 234 279 279 233 238 121 115 116 111 102  88  75  65  64  81 152 221 207
  60   4   16  19  28  52 100 152 122  18   9  28  87 170 223 262 262 224 208 118 117 116 111 101  88  74  65  62  75 138 198 183
  40   3   16  20  29  55 105 146  93  14   8  27  86 165 215 250 251 216 187 116 118 116 110 101  87  74  64  60  70 126 178 162
  20   2   16  20  30  56 106 139  73  11   8  27  84 158 208 240 241 208 173 114 117 115 110 100  87  73  63  59  66 117 163 149
   0   1   16  20  29  56 106 138  72  11   8  29  86 159 209 241 241 208 173 114 117 115 109  99  86  73  63  58  66 116 161 146
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*** CC FIELD FOR LAYER K=    1 , RATIO=    1.00
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    XUTM=  725  727  729  731  733  735  736  737  738  739  740  741  742  743  744  745  746  747  748  749  750  751  752  753  754  755  757  759  761  763
       I=    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29   30

4310  40     0    0    1    0    0    0    0    0    0    1    2    2    3    5    3    0    0    2    3    1    0    1    2    2    5    7    0    0    0    0
4308  39     1    1    1    1    0    1    1    1    1    2    4    9   25   36   25   20   15   34   23    2    0    0    3   13   15    8    1    2    0    0
4306  38     1    1    1    1    1    1    0    0    0    2    9   15   25   26   19   27   37   47    9    6   12   15   18    9   16    1    1    2    0    0
4304  37     1    1    1    1    1    0    0    3   19   17    8   12   13   15   28   51   50   23    6   28   59   68   30   17    8    2    0    1    0    0
4302  36     1    1    1    0    0    1   27   65   62   18    4    9   17   41   77   89   49   12   24   49   59   41   17   12    6    0    0    0    0    0
4300  35     1    0    0    0    2   42  103  106   55   10    6   22   54   98  127  106   44   15   37   57   72   92   64   17    4    2    0    1    3    5
4298  34     1    3    4    5   32  112  132   92   36    9   25   64  110  149  147  100   43   32   61   95  125  130   79   20    2    2    0    2    5    9
4296  33     3    7   10   26   78  148  118   68   29   34   71  120  161  173  141   91   56   60   96  129  136  108   48   13    1    1    1    3    5    6
4294  32     4    6   14   52  109  142   91   58   43   63  113  153  173  163  128   94   77   89  119  135  116   66   32    8    0    1    1    3    4    3
4292  31     8   16   37   70  119  125   79   64   67   93  139  165  172  154  123   99   88   98  116  112   81   44   23    5    0    2    2    3    4    1
4291  30    10   23   50   78  121  118   76   69   80  114  148  167  169  150  122  101   91  100  111   98   66   39   18    6    0    2    2    4    3    1
4290  29    13   30   56   84  122  111   75   74   90  123  152  167  164  145  121  101   92   99  103   88   67   44   20    9    5    2    3    4    3    1
4289  28    17   34   57   89  121  102   74   80   99  127  153  165  159  140  120  100   91   96   97   83   69   44   29    9   14    1    3    4    3    2
4288  27    19   36   61   93  119   97   75   84  109  143  166  163  156  137  117   96   87   96   97   82   65   40   16    8    7    0    3    3    3    4
4287  26    22   40   65   96  115   92   78   92  128  165  178  162  152  134  112   93   92  103  105   89   68   29    8    4    4    1    3    2    2    3
4286  25    25   44   68   98  112   89   83  109  151  172  179  161  146  129  108   97  107  113  113   93   55   17    6    6    2    1    2    2    4    4
4285  24    27   46   71  100  110   89   91  124  168  183  174  153  142  125  106  102  120  121   97   73   37   11    7    8    0    1    2    5   11    5
4284  23    29   49   73   99  106   87  100  142  177  194  175  153  139  118  105  113  127  118   85   56   26    9    5    5    2    1    3    9   16    6
4283  22    30   50   75  100  102   90  128  171  193  203  189  170  145  126  166  177  120  101   69   43   20    7    4    4    6    3    5   15   18    3
4282  21    32   52   78  101  103  110  172  200  215  211  199  183  164  164  206  172  104   84   57   35   15    4    4    6    4    4    8   20   21    0
4281  20    34   54   80  102  109  148  198  216  225  223  207  197  189  215  250  163   87   70   50   28   11    5    5    7    3    6    9   18   15    0
4280  19    36   55   81  102  117  186  234  223  231  233  225  215  231  278  265  143   72   60   43   23   13   14   16    7    3    7    8   17   11    0
4279  18    37   56   82  103  124  187  215  219  242  238  227  244  288  318  258  115   58   54   41   27   28   43   48   12    2    8   13   15    9    0
4278  17    39   59   84  107  136  186  202  214  229  221  225  262  307  331  239   87   50   59   57   41   42   58   42    8    5    9   18   11    5    0
4277  16    42   63   86  112  149  199  203  215  233  223  240  291  337  336  192   65   54   75   70   52   48   55   21    7    9    9   16    8    4    0
4276  15    43   63   88  115  154  199  214  218  236  251  277  332  361  312  138   55   68   95   80   54   56   44   13    8   11    9   18    8    5    1
4275  14    45   66   90  119  165  217  225  217  241  268  321  371  368  257  100   54   81  100   77   54   42   31   20   22   24   14   16   11    8    2
4274  13    50   71   96  130  155  255  238  222  262  309  357  426  394  185   85   66   83   86   67   55   36   28   24   21   29   21   14   13    8    2
4273  12    55   76  103  136  200  270  249  238  282  337  399  446  330  140  141  148   77   77   60   49   36   22   18   19   24   20   12   15    5    1
4272  11    56   77  104  142  205  258  243  260  316  382  432  387  251  165  188  127   65   66   53   44   30   27   12   18   22   22   11   10    5    1
4270  10    55   77  107  149  194  213  235  323  352  392  365  289  216  179  148   89   69   62   55   44   34   23   11   18   20   22   22    8    2    2
4268   9    56   78  110  153  203  316  432  273  363  335  296  242  194  147  101   68   63   54   50   35   23   14   13   18   19   21   24   20    7    5
4266   8    57   81  117  162  224  356  433  322  306  287  254  210  162  113   76   58   54   47   41   26   16   11   14   17   17   17   19   25   30   18
4264   7    60   86  124  173  250  366  380  306  258  257  220  178  133   94   66   53   48   41   34   21   13   12   14   16   15   15   17   26   35   13
4262   6    63   92  133  190  266  346  310  258  239  229  190  151  113   82   60   48   43   37   30   19   13   12   13   14   14   15   18   24   21    3
4260   5    66   97  142  201  270  316  272  240  216  199  162  128   95   70   53   45   39   34   27   18   13   11   12   13   14   15   18   19    9    0
4258   4    70  101  150  208  265  287  244  217  193  176  145  116   90   74   56   38   36   32   25   17   13   11   12   13   15   16   17   14    4    0
4256   3    74  107  156  210  255  258  215  193  174  156  130  106   82   64   46   34   34   29   23   17   13   11   12   14   15   16   15   10    2    0
4254   2    78  112  160  208  240  228  188  172  157  139  116   94   70   50   37   33   31   26   20   15   12   11   12   14   15   15   13    7    1    0
4252   1    82  115  160  201  221  200  167  156  142  125  104   82   58   41   33   30   28   23   18   14   11   11   12   14   14   13   10    4    0    0

** 2HR STATION SO2 ** MO,DAY,HR=  2/ 1/ 4/,  NTS=  34,   ... SPATIAL AVERAGE... CAL=  118 OBS=    0
 IS     1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25
 XS  14.2 12.5 17.6 17.3 13.7  8.7 10.2 18.4 25.4 17.2  3.8  4.5  7.7 14.3 26.1 28.9 27.8 13.1  2.4 -1.0  3.7 11.6 36.2 19.3-13.8
 YS  17.9 24.0 20.5 15.3 14.5 15.6 20.6 29.1 17.9 10.8 10.5 18.9 27.8 32.7 22.9 28.1 10.8  5.6  9.3 23.0 35.2 48.6 24.4 -7.7 20.2
CAL   275  145   82   75  275  232  202  107    3   70  338  114   93  147    1    3   10   98  104   26    1    2    4   13   31
OBS     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
... IYR,IMO,IDAY,IHR = 75/ 2/ 1/ 4/ .......
  ***** RAMS DATA *****
IS     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    21    22    23    24    25
UU   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0   5.0
DD   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.   45.
T1    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
T2    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
CC    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
RA    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.

RH=  1.00  GRID Z(K)=      0.    20.    40.    60.    80.   100.   125.   150.   175.   200.   225.   250.   275.   300.
                UZF(K)=   1.00   1.11   1.23   1.31   1.37   1.41   1.46   1.49   1.49   1.49   1.49   1.49   1.49   1.49
                VZF(K)=   1.00   1.11   1.23   1.31   1.37   1.41   1.46   1.49   1.49   1.49   1.49   1.49   1.49   1.49
                AKF(K)=   1.92   2.77   4.26   5.51   6.34   7.47   8.26   8.83   9.22   9.45   9.56   9.56   9.47   0.50
             KZ(J=JM/2)=    2.4    2.4    2.5    7.3    4.8    6.6    5.8    3.5    2.4    2.1    1.9    2.0    1.6    1.9    2.2
DT= 180.0     PARM(N)=         5.00       45.00        0.0          0.50     300.00     3545.86   14378.01        0.0          0.0        318.23
  UU=   0.449  PHZ=   0.888  HFZ=    3.901  RIB=    0.0

** VERTICAL PROFILE OF * C1 AT I= 15; J= 19**

    XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
       I=   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30
  Z   K
300  14   125 139 138 121 119 109  59  42  49  77 141 274 355 195  15   3   3   2   1   1   2   2   1   1   2   3   4   3   0   0
275  13   125 139 138 121 120 109  59  42  49  78 142 274 354 197  15   3   3   2   1   1   2   2   1   1   2   3   4   3   0   0
250  12   125 139 138 121 120 111  60  43  50  79 143 274 351 202  16   3   3   2   1   1   2   3   2   2   2   3   4   3   0   0
225  11   125 139 139 122 122 113  63  45  52  81 145 274 347 205  17   3   3   2   2   1   2   3   2   2   2   3   4   3   0   0
200  10   125 140 139 123 123 116  66  48  55  83 147 273 342 199  16   4   3   2   2   1   2   4   2   2   3   4   5   4   0   0
175   9   125 140 140 124 125 120  70  52  59  87 150 272 335 186  16   4   3   3   2   1   3   6   3   2   3   4   6   4   0   0
150   8   125 140 141 125 128 125  75  57  63  91 154 271 326 171  14   4   3   3   2   2   3   8   4   2   3   5   6   5   0   0
125   7   125 140 142 127 131 133  82  63  69  97 159 271 318 157  14   4   4   3   2   2   4  12   5   3   4   5   7   6   0   0
100   6   125 141 143 129 135 143  93  72  77 104 167 272 311 146  13   5   4   3   2   2   6  17   7   3   5   6   8   7   1   0
 80   5   125 141 144 132 140 154 104  81  85 112 175 275 307 140  13   5   5   3   2   3   7  20   9   4   5   7   9   9   1   0
 60   4   125 141 146 134 145 170 121  93  96 122 136 282 306 137  12   6   5   4   3   4   9  21  10   5   6   8  10  10   2   0
 40   3   125 141 147 138 152 190 141 107 107 133 199 289 306 136  12   7   6   4   3   5  12  23  13   5   7   9  11  12   3   0
 20   2   124 141 148 139 153 190 137 107 109 134 199 288 302 132  12   6   6   4   3   5  12  22  13   6   7   9  11  14   4   0
  0   1   123 140 148 140 153 190 138 108 109 134 198 286 300 131  12   6   5   4   3   5  12  22  13   6   7   9  11  14   4   0

    YUTM=426242644266426842704272427342744275427642774278427942804281428242834284428542864287428842894290429142924294429642984300
       J=   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35
  Z   K
300  14     8  11  14  16  19  43  64  27  25   5   3   4   5  15 103  54  68  21   8   3   4  12  27  49  72  93 118 107 235 657
275  13     8  11  14  16  19  44  67  28  21   5   3   4   5  15 107  55  72  22   8   3   4  12  27  49  72  93 118 107 227 627
250  12     9  11  14  16  19  46  76  30  18   5   3   4   5  16 120  61  83  25   8   3   4  12  27  49  72  93 118 106 212 572
225  11     9  11  14  16  20  51  94  33  17   5   3   4   5  17 131  68 105  29   9   3   4  12  27  49  72  92 118 105 191 500
200  10     9  12  15  17  21  57 124  39  16   5   3   4   5  16 125  75 138  36  10   4   4  12  27  49  72  92 118 104 167 419
175   9     9  12  15  18  22  65 171  49  16   6   4   5   5  16 109  84 191  47  12   4   4  12  27  49  72  92 118 103 142 337
150   8     9  12  16  19  24  75 245  63  17   6   4   5   5  14  90  94 272  63  14   5   4  12  27  48  72  92 117 101 120 264
125   7     9  13  17  20  26  87 351  83  19   7   4   5   6  14  75 105 376  86  17   6   4  12  27  48  71  91 117 100 101 204
100   6    10  13  18  22  29  95 386  95  20   8   5   6   6  13  64 110 368  89  20   7   5  12  27  48  71  91 116  98  86 157
 80   5    10  14  18  24  32  97 343  91  22   9   6   7   6  13  58 109 300  78  23   8   5  12  27  48  71  90 116  97  77 127
 60   4    10  14  19  26  35  96 271  79  24  11   8   9   7  12  54 106 241  69  26  10   5  12  27  48  70  90 115  96  69 104
 40   3    11  15  20  28  39  95 218  70  25  12  10  11   8  12  50 104 200  64  28  11   5  13  27  48  70  89 115  95  63  86
 20   2    11  15  21  29  41  92 182  64  27  13   9  13   7  12  48 101 172  59  29  11   5  13  27  48  70  89 114  95  58  73
  0   1    11  15  21  29  41  91 180  63  27  13   9  13   7  12  47 101 170  59  29  11   5  13  27  47  70  89 113  94  58  72
```

```
*** CC FIELD FOR LAYER K=   1 , RATIO=   1.00
..... PAGE =     1

    XUTM= 725 727 729 731 733 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 757 759 761 763
      I=    1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30

4310  40    1   1   1   0   0   0   0   0   0   1   2   2   5   5   0   0   2   5   3   1   1   2   3   4   8   5   0   0   0   0
4308  39    1   1   1   1   1   1   1   1   3   6  10  13  34  29  28  22  32  32  13   0   0   3   9  16  11   5   1   2   0   0
4306  38    1   1   1   1   0   0   0   3   7   9  13  17  23  27  39  42  25  15  11  25  29  27  11  12   7   1   1   2   0   0
4304  37    1   1   1   0   0  13  28  21   8   6   8  15  29  47  54  33  27  34  51  61  49  29  21  11   4   2   0   1   0   0
4302  36    1   1   0   4  37  78  52  23   7   8  26  54  82  97  84  53  36  40  39  28  18  19  20  10   2   0   0   0   0   0
4300  35    0   0   9  47  91  86  37  17  25  58  97 131 142 127  85  46  33  42  56  73  86  65  27   6   4   2   0   1   4   4
4298  34    4  19  54  95 139  65  42  61  97 137 167 173 148 106  67  55  71  98 120 174  98  48  12   2   2   2   1   3   7   7
4296  33   22  49  88 117 134  75  95 129 163 187 185 161 123  91  80  93 113 124 114  83  42  13   2   1   1   1   2   4   5   3
4294  32   39  68 100 118 104 109 144 171 183 177 157 129 105  96 100 109 109  96  70  43  16   3   4   2   1   2   3   4   3   1
4292  31   59  91 118 115 115 138 166 176 171 155 134 114 102  98  97  93  81  60  37  18   6   3   5   3   2   3   3   3   2   0
4291  30   69 103 125 115 123 153 171 173 162 144 124 109 102  97  91  82  65  43  23  10   7   4   6   4   2   3   3   3   2   0
4290  29   79 111 123 117 132 160 168 165 151 132 116 135  97  90  82  68  50  30  16  18  18  16  11  11   6   3   3   3   1   0
4289  28   86 112 119 121 139 161 162 154 136 120 108  99  99  81  71  55  37  23  19  25  24  23  18  14   9   2   3   2   2   1
4288  27   91 113 120 125 144 160 153 145 138 130 104  91  82  72  59  42  29  27  27  30  25  16  11   8   3   2   2   2   2   3
4287  26   95 115 120 129 145 155 149 152 153 129  98  82  73  62  49  39  36  42  42  40  23   9   5   3   2   2   2   1   2   2
4286  25   99 116 121 132 146 154 159 170 143 109  89  75  64  55  47  51  57  51  49  33  11   4   6   4   1   2   1   1   4   3
4285  24  101 117 122 134 148 161 167 159 132  93  76  66  58  53  54  64  67  46  26  12   4   5   9   4   1   1   2   6  12   3
4284  23  103 117 123 135 149 163 163 140 122  98  76  64  54  52  74  72  58  32  12   5   4   5   7   3   2   2   4  11  16   3
4283  22  103 117 124 137 150 168 163 142 120 105  93  80  71 113 178  73  37  14   4   4   5   4   3   5   5   4   8  19  14   0
4282  21  104 118 127 140 137 184 181 153 132 113 137 110 140 203 113  37  18   6   4   4   3   3   6   5   4   6  11  22  13   0
4281  20  105 119 130 145 172 208 177 152 140 131 140 182 259 265  64  18   8   5   5   3   3   6   7   5   6   8  13  17   7   0
4280  19  106 119 131 150 135 228 188 159 155 163 215 291 310 156  31  10   6   4   4   6  12  22  14   6   7   9  11  14   5   0
4279  18  107 119 134 157 187 195 161 169 187 221 294 320 225  78  21   6   5   7  12  23  41  60  31   9   7  11  14  10   3   0
4278  17  108 122 138 165 189 167 154 182 212 264 299 247 148  60  17   5  10  27  40  44  64  47  20  10  10  13  17   4   1   0
4277  16  110 126 144 171 188 175 176 216 263 281 265 198 101  40  12  11  34  54  59  58  51  27   8  10  12  12  12   2   1   0
4276  15  112 128 148 172 183 187 212 253 288 285 238 167  89  33  12  31  63  75  65  52  38  18  13  15  12  11  12   3   3   1
4275  14  114 132 152 174 135 224 244 268 282 260 223 183  80  26  23  51  73  71  58  34  19  23  26  30  21  14  10   6   7   2
4274  13  121 140 160 188 239 279 266 270 279 250 216 166  57  22  56  62  60  51  42  20  22  28  27  27  26  18   8  10   6   1
4273  12  127 147 169 199 252 300 279 269 262 233 199 121  42  84 170  75  46  38  29  20  27  22  21  21  20  15   7  12   3   0
4272  11  129 151 175 213 261 285 278 271 253 213 151  97 117 154  95  40  32  29  28  31  34  21  15  17  19  15   6   6   3   1
4270  10  134 158 188 222 243 243 259 245 210 158 117 134 102  76  49  38  35  33  31  29  26  18  15  16  17  19  17   4   1   2
4268   9  142 168 198 231 268 364 288 177 151 110  85  72  59  43  32  29  28  25  22  18  15  14  14  15  16  17  18  16   7   4
4266   8  151 183 213 251 291 328 251 132  97  72  57  46  38  29  23  20  18  16  14  13  12  12  13  13  13  13  18  29  31  13
4264   7  163 196 233 269 283 237 152  87  63  49  39  32  27  22  17  15  13  12  11  11  11  11  12  12  12  14  20  30  20   6
4262   6  179 215 250 264 230 139  84  58  45  35  29  24  19  16  13  12  11  11  10  10  10  11  11  12  14  16  19  13  11   0
4260   5  196 229 249 234 173  90  57  41  32  25  19  14  11  10  11  11  10  10  10  10  10  11  12  13  14  15  14   9   1   0
4258   4  208 232 232 195 128  59  41  31  25  22  19  16  18  21  13   8  10  10  10  10  11  12  12  13  13  12   9   3   0   0
4256   3  212 225 206 157  93  38  32  26  22  17  17  15  15  14  10   8   9   9  10  11  12  12  12  11  10   9   5   2   1   0
4254   2  209 208 176 123  68  28  26  22  19  16  13  11  10   9   8   9   9  10  10  11  11  11  10   9   7   6   3   1   1   0
4252   1  198 188 149  99  53  23  23  20  16  13  11   9   8   8   9   9  10  10  10  10  10   9   8   6   5   4   1   0   0   0

** 2HR STATION SO2 ** MO,DAY,HR= 2/ 1/ 5/,  PTS= .04,    ... SPATIAL AVERAGE... CAL=   77 OBS=    0
 IS      1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    21    22    23    24    25
 XS   14.2  12.5  17.6  17.3  13.7   8.7  10.2  18.4  25.4  17.2   8.8   4.5   7.7  14.3  26.1  28.9  27.8  13.1   2.4  -1.0   3.7  11.6  36.2  19.3-13.8
 YS   17.9  24.0  20.5  15.3  14.5  15.6  20.6  29.1  17.3  10.8  10.5  18.9  27.8  32.7  32.9  28.1  10.8   5.6   9.3  23.9  25.2  48.6  24.4  -7.7  20.2
CAL     51    62     7    55    29   264   109    22    11    34   242   179   154    81     2     2     7    19   187   100    26     4     3    10   104
OBS      0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
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5. Report of IBMAQ-1

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A Generalized Urban Air Pollution Model and Its Application to the Study of SO_2 Distributions in the St. Louis Metropolitan Area

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ABSTRACT

A generalized urban air pollution model, based on numerical integration of the concentration equation, is developed for the study of air pollutant distributions over an urban area. The model computes the temporal and three-dimensional spatial concentration distributions resulting from specified multiple point and area sources by using currently available meteorological and source inventory data. A new method based on experiments and a turbulence transport model is used to estimate the turbulent diffusivity and atmospheric stability. Special treatments of the finite-difference scheme to accommodate the large variations of concentrations are discussed. An effort has been made to avoid any subjective analysis scheme for the preparation of the input data.

The model was used to study SO_2 distributions in the St. Louis metropolitan area during 25 consecutive days in February 1965. The computed results were evaluated with respect to observed data by using various statistical methods. The computed results agree favorably with experimental measurements for both long-term and short-term average concentrations. Computations also indicate the model's capabilities and flexibilities for dealing with the rapid variations of atmospheric conditions. The advantages and limitations of the model are also discussed.

1. Introduction

In recent years, a number of urban air quality diffusion models have been developed. Such models can be used to study the complicated relationships between air quality and emission sources as a function of various parameters, *viz.* meteorological and surface conditions. The aim of these models is toward air quality prediction as well as long-term air quality management planning. In view of the long standing air pollution problems and growing emphasis on air quality improvements, the subject has great practical importance. However, the present state of the art in diffusion modelling raises some doubts about the possibility and feasibility for achieving these goals. The objective of this work is to develop a model through which we can study thoroughly the relation between air quality and sources as well as the feasibility of its eventual use in air quality prediction and management. In general, these models are formulated by the use of a concentration equation governing the pollutant mass which are based on the physical principle of mass conservation. The governing concentration equation, supposedly, can be solved for given input of the source emission rates, meteorological and surface conditions, turbulent transport mechanism, and transformation rates. However, due to the complex process of the air motion in an urban atmosphere and inadequate data acquisition, the required detailed information for the input is not available. Thus, for practical purposes, various approaches have been developed, based on either statistical theory, or phenomena, or even arbitrary assumptions. The choice of the approach, more often than not, depends on its applicability and convenience.

The simplest formulation is the box-type diffusion model (Frenkiel, 1956; Leahey, 1972) which assumes the vertical pollutant distribution to be uniform inside the atmospheric mixing layer. It offers a quick result for long-term concentrations.

Another type of simple model reported by Gifford and Hanna (1970) is based on the similarity hypothesis. This approach assumes that the vertical concentration distribution is similar with respect to a height scale along the wind axis. This height, called the height of the polluted air, is determined by the requirement of separation of variables in the governing equation. The application of the model gave some good results for long-term averaged concentrations. A somewhat similar approach with more complicated formulation was reported by MacCracken *et al.* (1972).

The best known of the practical equations based on statistical theory is the Gaussian plume formula which was evolved from the solution of the concentration equation under isotropic, homogeneous condition. It assumes that at downwind from a point source, the ensemble average concentration on the crosswind plane will approximate a normal statistical distribution. At present, many existing urban diffusion models are primarily based on Gaussian formulations. The models developed by Turner (1964), Roberts *et al.* (1970), Johnson *et al.* (1970), Shieh *et al.* (1972) are a few typical examples. Reviews of existing models are reported by Moses (1969) and Neiberger (1971).

On the other hand, the concentration diffusion equation has not been widely used in this kind of study. When properly applied, the equation can give a better description of atmospheric diffusion processes. There are various solutions of this equation for point sources with the specified atmospheric conditions, such as those of Rounds (1955), Iordanov (1966), Shir (1970, 1972a) and many others. Its application to a multiple source urban diffusion model is still considered to be at a beginning stage. A few models, such as those of Harrington (1965), Sklarew *et al.* (1972), Lamb and Neiburger (1971), Randerson (1970) and Reynolds *et al.* (1973) have been developed, but a more extensive test of this approach had yet to be made.

It is well known that the major factors that characterize diffusion processes in the atmosphere are the state of atmospheric turbulence and its underlying surface properties. It is apparent that the Gaussian plume formula is not flexible enough to include all possible variations that the air motion experiences under urban atmospheric conditions. If a model has to accommodate the temporal and spatial variations of meteorological parameters, effects of the inhomogeneous surface conditions and other features, a realistic approach as we see it, lies in the application of the concentration diffusion equation. It is possible that the availability and accuracy of input data for the models, both for meteorological parameters and source inventory, will be improved in the future. Therefore, application of this kind of model would be far more advantageous.

In this study, we propose a new urban diffusion model, based on a concentration diffusion equation. The major purposes of this study are the following:

1. To investigate the feasibility of using concentration diffusion equation for a diffusion computation which involves multiple source emissions.
2. To develop a numerical technique which is to handle the inhomogeneity of multiple-source emission rates, the complex urban atmosphere, and the change of surface boundary conditions.
3. To obtain a practical method such that the model can utilize current available meteorological and source inventory data.
4. To develop a general method such that the model computation will not require any subjective analyses, arbitrary adjusted parameters, and "tune up."

2. Input data

The basic data used in this study were obtained from the Division of Meteorology, Air Program Office, U. S. Environmental Protection Agency. Originally, the data were collected for the purpose of St. Louis SO_2 dispersion model study as part of the Interstate Study (Venezia and Ozolin, 1966), covering the period from 1 December 1964 to 28 February 1965. The data consists of source emission inventory, meteorological variables, and SO_2 concentrations at monitoring stations. It should be noted that the original concept of the St. Louis SO_2 dispersion study was for the developing of a Gaussian type model. Consequently, this set of data was gathered for this specific purpose. The detailed description of these data can be found in Turner and Edmisten (1968). However, these data are not compatible with the requirement of the gradient transport type of diffusion model, and additional analysis was therefore necessary. The following discussion will briefly describe the basic data.

a. SO_2 source emission data

The St. Louis, Missouri–East St. Louis, Illinois Metropolitan area is divided into 1200 square area source grids, 30 squares in the east–west direction and 40 squares in the north–south direction (see Fig. 1). The dimensions of the grids are 5000 ft on the sides. In addition, Fig. 1 also shows 44 industrial point sources within the region. No adjustments have been made to the emission data when applied in our diffusion computations.

The time dependent source emission rate (gm sec^{-1}), averaged over a 2 hr period, for each area source and point source are computed by equations which can be found in Turner and Edmisten (1968). The method of calculating these emission rates and its validation have been discussed by Turner (1968). No adjustments have been made to the emission data when applied in these diffusion computations.

In addition to source emission data, two additional sets of data are included. First, the average building height of each area source grid was used to estimate the surface roughness. Second, the stack height of point sources and the values of plume rise time wind speed (m^2 sec^{-1}) are also included. For cases when no plume rise information was given, the plume rise was estimated from the SO_2 emission.

b. Meteorological data

Hourly averaged meteorological data are routinely obtained at two airports in St. Louis area: Lambert

Field and Scott Field. The data consist of surface wind direction and speed, sky cover, surface temperature, visibility and weather conditions, etc. The hourly averaged surface temperature, wind direction and speed are also measured at three stations on the periphery of the urban area. They are located at Lindbergh High School, the Missouri State police station, and Hazelwood High School. The instruments' specifications and operation were described by McElroy and Pooler (1968). In addition, the instruments which measured wind speed, direction and temperature were installed at KMOX-TV tower located in downtown St. Louis (see McElroy and Pooler, 1968). This operation consists of three levels of instrumentation and one level of bivane standard deviation. The location of measurement sensor stations is given in Fig. 2.

c. Mixing heights

The data of two daily mixing heights, namely, one morning minimum and one afternoon maximum height, estimated by EPA were used. These heights represent the level at which the adiabatic lapse rate (based on estimated surface urban temperature) intersects the rural temperature profile measured by morning radiosondes. This intersection height may be in error due to an ill-defined temperature profile or over-estimated urban surface temperatures. The average range of heights is 300 m to about 600 m.

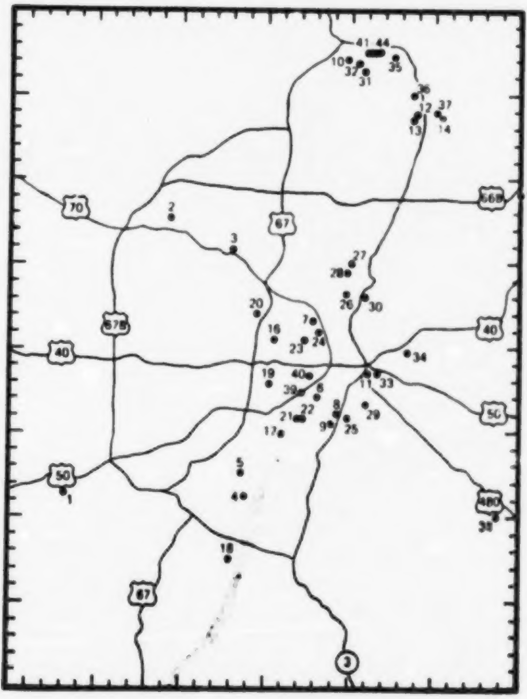

FIG. 1. Geographical distribution of area and point sources for the St. Louis metropolitan area.

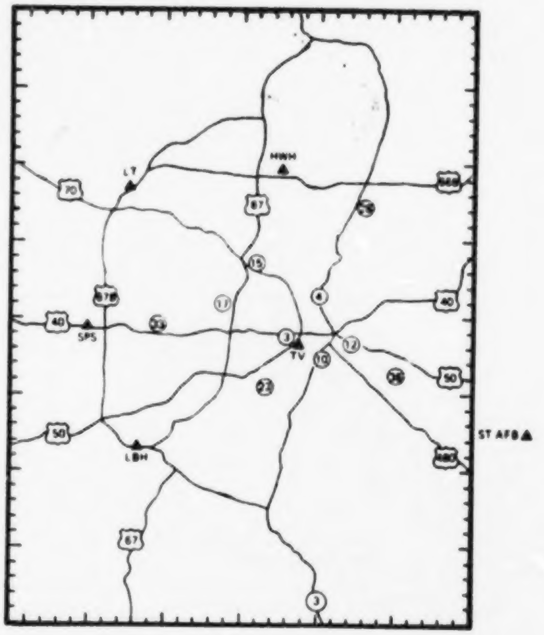

FIG. 2. Locations of meteorological stations and the SO_2 monitoring network in the St. Louis metropolitan area.

d. SO_2 concentration

Fig. 2 also shows the sampling stations where SO_2 concentrations are measured. Original data consisted of 40 stations where concentrations were obtained for a 24-hr averaging period. At ten of these stations additional 2-hr averaged concentrations were made. The detailed description of the instrumentation and its operation are given by Farmer and Williams (1966). The validation of this model is based on the latter 10 stations where 2-hr averaged concentrations were measured.

3. Model formulation

a. Equations, boundary conditions and initial conditions

The region of interest is the St. Louis metropolitan area. This area encompasses 30×40 square area source grids based on the emission inventory made by Turner and Edmisten (1968) (Fig. 1). The time varying mixing depth is taken as the upper limit of the model. Since this area has a reasonably flat terrain, the effects of topography are neglected. The surface roughness parameter is used to represent the effects of urban buildings. SO_2 emission is considered passive and therefore does not alter the meteorological conditions. The turbulent diffusion of SO_2 is assumed to be of the gradient diffusion type. The governing equation of SO_2

in the atmosphere based on the conservation law is

$$\frac{\partial C}{\partial t}+\nabla\cdot \mathbf{V}C=K_H\nabla_H^2C+\frac{\partial}{\partial z}K\frac{\partial C}{\partial z}+Q+R, \qquad (1)$$

where C is the mean concentration of SO_2, $\mathbf{V}=(U,V,W)$ is the mean wind vector, Q the source strength rate, R the chemical reaction rate, K_H the horizontal eddy diffusivity, ∇_H^2 the horizontal Laplacian operator, and K the vertical eddy diffusivity. The boundary conditions are:

$$K\frac{\partial C}{\partial z}=0, \quad z=0, H \qquad (2)$$

$$\frac{\partial^2 C}{\partial x^2}=0, \quad x=0, x_{max} \qquad (3)$$

$$\frac{\partial^2 C}{\partial y^2}=0, \quad y=0, y_{max}. \qquad (4)$$

Here $H=H(t)$ is the mixing depth of the planetary boundary layer, and x_{max} and y_{max} are the east and north boundaries of the area respectively. The boundary surfaces above and below are assumed impermeable to the SO_2. The absorption of the SO_2 by the ground surfaces is neglected. The exact lateral boundary conditions are not available. Those conditions in (3) and (4) which extrapolate the concentration outside the region serve as a reasonable approximation when the region of computation is large enough. In practice, and as we have found, the lack of well-posed boundary conditions does not cause serious problems. This is because the horizontal advection terms, which dominate the horizontal diffusion terms, are only first order in the space derivative. The computation may be affected by the inflow boundary conditions. However, if there is no high concentration outside the inflow boundary this influence is minimum, and the linear extrapolation could offer a fair approximation. In this study, the region computed is about ten times that of the urban area where the major sources are located. Moreover, there is neither any nearby major urban area nor any return flow to influence the inflow boundary conditions. The initial conditions are arbitrarily set to zero. The computations show that the concentrations reach observed levels within approximately 2 hr under average wind speed conditions. Hence the initial conditions are not important for the concentration computations after this initial time. This required time period depends on the wind speed and the region of interest. This time interval can be estimated by $T_u\approx L/\bar{u}$, where L is the distance downwind from the sources and $\bar{u}$ the average wind speed. However, this may not be valid when the wind changes direction drastically during this time period. The model simulation begins at 1400 Local Standard Time (LST) which corresponds to the time period used in the source emission inventory and data acquisition system.

b. Physical parameters

The parameters required for the integration of Eq. (1) are $\mathbf{V}$, K_H, K, Q, R and H which, except for Q, are not provided explicitly or sufficiently. The following discussions outline the methods which were used to obtain the input data for the model requirement.

1) WIND FIELD

The wind vector $\mathbf{V}=\mathbf{V}(x,y,z,t)$ is required at every grid point for each time step of integration. The hourly averaged surface wind field for the total region was obtained by using a weighted interpolation scheme. Data from the measurement stations were interpolated to a square grid, which had a size of five area source dimensions. Several schemes have been tested in this analysis. It was found that reasonable results can be obtained from the equations (Wendell, 1970):

$$\hat{u}_{ij}=\sum_{m,n}(\hat{u}_{mn}/r_{mn}^2)\Big/\sum_{m,n}(1/r_{mn}^2), \qquad (5a)$$

$$\hat{v}_{ij}=\sum_{m,n}(\hat{v}_{mn}/r_{mn}^2)\Big/\sum_{m,n}(1/r_{mn}^2), \qquad (5b)$$

where u_{ij} and $\hat{v}_{ij}$ are components of the wind vector at analysis grids in the x and y directions, respectively; and $\hat{u}_{mn}$ and $\hat{v}_{mn}$ are the initial guess fields at analysis grid and r_{mn} the distance from grid (i,j) to grid (m,n). The initial guess field is obtained by assuming

$$\left.\begin{array}{l}\hat{u}_{mn}=u_k\\ \hat{v}_{mn}=v_k\end{array}\right| \text{for minimum of } r_k,$$

where u_k and v_k are components of the wind vector measured at station k and r_k is the distance from a grid to station k. From this analyzed wind field a linear interpolation is employed to obtain a wind vector at each grid point to be used in the numerical scheme.

The mesoscale wind field analysis is a very difficult problem. In reality, we don't think this simple method will be able to handle all possible meteorological conditions. Due to the limited number of measurement stations, a more complex method is not applicable in our study. In this study, an attempt was made to avoid any subjective analysis methods. Thus, throughout our computations the same analysis procedure was applied without any subjective adjustments. In the later part of our study we became aware of the existence of a complete subjectively analyzed wind field for this period (Turner, 1972, personal communication). The model performance based on this wind field as compared to our method will be discussed in Section 5.

The spatial distribution of upper layer wind data was not available, and the present knowledge of urban meteorology cannot offer much information about it.

Fortunately, the concentrations at those locations where the local sources dominated are not sensitive to the upper wind. The vertical wind profiles at each grid location are assumed to be of power law form

$$|\mathbf{V}| = |\mathbf{V}_s| (z/z_s)^p, \tag{6}$$

where $\mathbf{V}$ and $\mathbf{V}_s$ are the upper and surface wind at the height z and z_s respectively. The power constant p is determined by

$$p = \ln(|\mathbf{V}_3|/|\mathbf{V}_1|)/\ln(z_3/z_1), \tag{7}$$

where $\mathbf{V}_3$ and $\mathbf{V}_1$ are the winds at the height z_3 (140 m) and z_1 (39 m) of the TV tower. The values of p are restricted between 0.15 and 0.65 which are the usually observed values. The directions of the upper wind are also unknown. It is understood that the upper wind has a direction to the right of the surface wind in the Northern Hemisphere. However, this angle cannot be determined quantitatively from any theory under general conditions. Two methods have been tested. One method assumes no directional change and the other assumes equal angle change with height over each height interval from z_s to z_3 with the same total angle change as that measured at the TV tower. Results from both methods differ very little. Hence the assumption of constant wind direction with height was used for the computations. The vertical winds were calculated from horizontal winds through the continuity equation. Since the interpolated horizontal winds are so smooth, the vertical winds do not significantly influence the concentration distributions. This is in contrast to the case when a strong urban heat island occurs. However, the incomplete knowledge of the vertical winds resulting from the urban heat island effects make this assumption necessary.

2) ATMOSPHERIC STABILITY

It is well known that turbulent diffusion of air pollutants is directly related to the atmospheric turbulent intensity which is categorized by the stability of the atmosphere. But what is the practical way to describe the stability? From planetary boundary layer theory, the Richardson number Ri or Monin-Obukhov length L is used to represent the stability.

The availability of temperature and wind observation on the TV tower made it possible to compute a bulk Richardson number. McElroy and Pooler (1968) suggested that atmospheric stability can be categorized by a bulk Richardson number and bivane standard deviation. Our first attempt was to compute eddy exchange coefficients as a function of bulk Richardson number, bivane standard deviation, and surface roughness. It was found that this method gave inconsistent results. The deficiencies of this method are three-fold. First, the computed value of the Richardson number depends on the accuracy of the vertical temperature gradient measured at TV tower. Second, the TV tower is located in downtown St. Louis, and the parameters measured at this location may be influenced by nearby high buildings and local heat emission. Thus, the stability parameters based on these measurements may only represent the local stability condition. Third, the correlations between bulk Richardson number and bivane standard deviation are very poor. In the following discussion, we will present a method which is used in the final computation. This approach will enable an urban diffusion model to be based on the concentration diffusion equation without the benefit of vertical temperature measurements.

The basic stability classification proposed by Pasquill (1962) is employed. The wind speed at the lowest level of TV tower measurement (39 m) and sky cover observed at the two airports were used to establish the stability class. Pasquill's stability category is a discrete function (represented by stability classes A–F). It will be replaced by stability classes −3, −2, −1, 0, 1 and 2 in our discussion. (The stability class 0 represents neutral conditions.) Moreover, the stability class was evaluated as a continuous function by interpolating Pasquill's class with respect to wind speed. However, in the transient period, after sunrise and sunset, the past history of stability must also be considered. The detail of the interpolation scheme is given in Table 1.

TABLE 1. Key used to estimate the continuous stability classification.*

Mean wind speed (m sec⁻¹)	Day			Transient period		Night	
	Incoming solar radiation						
	Strong	Moderate	Slight	Day →	← Night	Thinly overcast or 4/8 low cloud	Cloud ≤3/8
<2	−3.5∼−3.0	−3.0∼−2.2	−2.5∼−2.0	−1.5∼−0.5	0.5∼1.5	1.5	2.5
2∼3	−3.0∼−2.2	−2.2∼−2.0	−2.0∼−1.0	−1.0∼−0.3	0.5∼1.0	1.5∼0.6	2.5∼1.6
3∼5	−2.2∼−1.5	−2.0∼−1.0	−1.0∼−0.5	−1.0∼−0.3	0.3∼0.5	0.6∼0.3	1.6∼0.5
5∼6	−1.5∼−1.0	−1.0∼−0.3	−0.5∼−0.2	−0.4∼−0.2	0.2∼0.4	0.3∼0.1	0.5∼0.3
6∼8	−1.0∼−0.3	−0.3∼−0.1	−0.2∼ 0	−0.3∼−0.1	0.1∼0.2	0.1∼0	0.3∼0.1
>8	−0.3	−0.1	0	0		0	0.1

* Note: 1) See Turner (1969) for overall explanations.
2) Zero index is equivalent to neutral condition.
3) An intermediate value is computed by a linear interpolation scheme according to the specified range of wind speed.

Recently, the relation between the specified Pasquill-Gifford stability classes and the physical parameters of turbulence was studied by Golder (1972). Golder found the relations between the Pasquill-Gifford's stability classes and the Monin-Obukhov length with surface roughness as an additional parameter. Golder's data can be approximated by the expressions

$$1/L=\pm[d\ln(1.2+10/z_0)]^2 10^{f(S)}, \tag{8}$$

$$f(S)=-a/(1+b|S|^c), \tag{9}$$

where S is the stability class; $a=4$, $b=1.3$, $c=0.85$, $d=0.216586$; and $z_0=z_0(x,y)$ is the surface roughness parameter in meters. The stability parameter $S=0$ denotes neutral conditions, and negative and positive values of S denote unstable and stable conditions, respectively. Thus, the sign of L in (8) must be the same as that of S. Moreover, the continuous values of S as discussed previously allow smooth changes between stability classes. Since this method is much easier to use than measuring vertical temperature distributions, its merits should not be overlooked. Certainly, it may require further improvements such as continuous insolation classifications, non-uniform spatial stability distributions, and effects of precipitations.

3) EDDY DIFFUSIVITY

To calculate eddy diffusivities of air pollutants is a classical problem. Not much information about their behavior are known except near the surface. Recently, Shir's turbulence transport model (1973) successfully calculated the turbulence structure in the planetary boundary layer. The vertical distribution of K under neutral conditions can be expressed as

$$K=u_*l,\quad l=k_0ze^{-4z/H}, \tag{10}$$

where u_*, k_0 and H are friction velocity, the von Kármán constant, and the height of the boundary layer, respectively. We assume that $K=K_sl/l_s$ for non-neutral conditions, where the subscript s denotes the values at $z=10$ m. From given L and $\mathbf{V}_s$ (wind velocity at $z=10$ m), we now calculate K_s from the following two procedures:

1. Calculate u_* from $\mathbf{V}_s$, L and z_0 by

$$u_*=k_0\mathbf{V}_s/\psi_m, \tag{11}$$

where $\psi_m=\int_{z_0}^{z}(\phi_m/z)dz$, ϕ_m being the non-dimensional wind shear. According to Businger *et al.* (1971), ϕ_m can be expressed as

$$\phi_m=\begin{cases}1+\alpha\zeta, & \zeta>0\\ (1-\beta\zeta)^{-\frac{1}{4}}, & \zeta<0\end{cases} \tag{12}$$

where $\zeta=z/L$, $\alpha=4.7$ and $\beta=15$. Using Eq. (12), we have

$$\psi_m=\begin{cases}\ln(1+z/z_0)+\alpha\zeta, \quad \text{for} \quad \zeta>0\\ \ln(1+z/z_0)-2\ln[(1+\omega)/2]-\ln[(1+\omega^2)/2]\\ \qquad +2\tan^{-1}\omega-\pi/2, \quad \text{for} \quad \zeta<0\end{cases} \tag{13}$$

where $\omega=1/\phi_m$.

2. Calculate K from u_* and ϕ_h by

$$K=u_*l/\phi_h, \tag{14}$$

where

$$\phi_h=\begin{cases}\gamma+\alpha\zeta, & \zeta>0\\ \gamma(1-\beta'\zeta)^{-\frac{1}{2}}, & \zeta<0\end{cases}$$

and $\gamma=0.74$, $\beta'=9$. The formulas (12)-(14) are valid in the surface layer. We calculate $K_s=K$ ($z=10$ m) and then extrapolate K to higher altitude by $K=K_sl/l_s$. This approach by no means implies that the turbulent diffusion of air pollutants over an urban area is really so simple. Those formulas are derived from experimental data based on equilibrium turbulence which may not occur over an urban area where the horizontal inhomogeneity plays an important role. Shir (1972b) found that turbulence is non-equilibrium in the vicinity of a change in surface roughness. However, little information is available about the urban effects on the eddy diffusivity. The formulas used here are subject to improvement when more knowledge about them is available. However, we feel that it is a significant improvement over existing methods because the effects of surface roughness are taken into account in the calculation of L and K. Shir (1972a) pointed out that the effects of surface roughness can influence the concentration distribution significantly. These effects are neglected in the Gaussian plume approach.

The horizontal eddy diffusivity K_H has no significant effect on the results and its behavior is not well understood, especially under stable conditions. In the present study, a value of 300 m² sec⁻¹ was assumed.

4) SURFACE ROUGHNESS

Although surface roughness affects the turbulent dispersion and wind profiles, no surface roughness measurements were made over the St. Louis urban area. Lettau (1970) proposed a simple formula to estimate the roughness length of the urban area by

$$z_0=0.5rh, \tag{15}$$

where r is the silhouette area ratio and h the effective height of the roughness elements. The values of r range from about 0.05 to 0.5 from rural to urban areas. The values of r are assumed to be proportional to the area emission sources density and are estimated as

$$r=0.04[1.0+0.37Q_a(x,y)/\bar{Q}], \tag{16}$$

where Q_a is the mean area source strength and $\bar{Q}$ the space average area source strength. This gives values of r ranging from 0.04 to 0.5 and values of z_0 from 0.4 m in suburban areas to 6 m in urban areas. These values offer a crude estimate of the roughness distributions in the St. Louis area. This formula is subject to improvement when more information is available on the effect of different urban areas on the values of r and z_0.

5) THE MIXING HEIGHT

Turbulent mixing plays an important role in the dispersion of pollutants in the atmospheric layer under the mixing height. This height may not always be the height of inversion layer. For instance, in a neutral atmosphere, there is a mixing height but no inversion height. For a horizontally homogeneous planetary boundary layer under neutral conditions, the mixing height is about equal to half the height $h_* = u_*/f$, where f is the Coriolis force parameter (Shir, 1973). However, the technique used to estimate the mixing height is actually that of estimating the inversion height.

The hourly mixing height was estimated by interpolation from the given minimum and maximum heights. The period of minimum height is assumed to last from the 0000 to 0600 LST and the maximum height from 1400 to 1800 LST. The morning minimum height was restricted to be lower than the previous day's maximum. The maximum height was kept less than 1200 m, because any height above that has little influence upon the surface concentrations within the region of investigation under normal wind speed. This can be shown by comparing the advection time scale T_a to the diffusion time scale T_d. Here $T_a = L/u$, where L is the length of the urban area and u the average surface wind speed at $z = 10$ m; and $T_d = H^2/K$, where H is the mixing height and K the average eddy diffusivity. Under neutral conditions, $K = u_* l = k_0 u l/(\ln 10) = 6u$; with $l = 30$ m this gives $\beta_1 = T_a/T_d = 6L/H^2$. In this study, $L = 20$ km, thus, $\beta_1 = 0.1$ for $H = 1000$ m and $\beta_1 = 1$ for $H = 300$ m. Therefore, when the mixing height is greater than 1000 m, the time of advection is much shorter than the time of diffusion, and the effects of the reflection from the inversion base become small.

6) CHEMICAL REACTION RATE

The chemical reaction rates of SO_2 can be expressed by $R = -k_a C$, where k_a is the reaction rate constant. The reaction rate depends on the insolation and the atmospheric concentrations of water vapor, nitric oxide, hydrocarbon and particulates. Its estimated values range from 10^{-3} to 10^{-7} sec^{-1} (Leighton, 1961). Wilson and Levy (1968) found values of k_a ranging from 0.8×10^{-4} to 1.4×10^{-4} sec^{-1} in smog chamber experiments with medium relative humidity. The value of $k_a = 10^{-4}$ sec^{-1} was used in this study. For normal wind speeds (5 m sec^{-1}), it is believed that the reaction rate is slower than the advection rate of wind over the medium size urban area. This can be estimated by $\gamma_1 = T_a/T_c$, where $T_c = k_a^{-1}$ is the time constant of reaction rate and $T_a = L/u$ is the time scale of advection. The chemical reaction effects will be pronounced when $u \le L/T_c$. In St. Louis, $L = 20$ km covers most of measurement stations. If $T_c = 3$ hr, then $u = 2$ m sec^{-1}. Thus, the chemical reaction effects are significant under low wind speed conditions ($u \le 2$ m sec^{-1}).

4. Methods of analysis

a. Grid specifications

Our three-dimensional grid system consists of $30\times40\times14 = 16800$ grid points. The x, y, z axes are oriented east west, north south, and vertically, respectively. The horizontal grid sizes $\Delta x = \Delta y = 5000$ ft $= 1524$ m were chosen according to the grid size of the emission source inventory. The vertical grid sizes are specified as follows:

$$\Delta z_k = \begin{cases} 20 \text{ m}, & 1 \le k \le 5 \\ 25 \text{ m}, & 6 \le k \le 9 \\ (H-200)/4, & 10 \le k \le 13, \quad \text{for } H \ge 300 \text{ m} \end{cases}$$

where H is the mixing height when $H \ge 300$ m. The lower nine grid points under 200 m have a fixed spatial size because the effective heights of point and area sources are within this layer. The levels of the upper four grid points are determined by the hourly varying mixing height. The grid spacing for these four grid points is set to be larger than or equal to 25 m. Thus, the minimum height of the grid system is 300 m. When the mixing height is lower than the top of the grid system, small values of eddy diffusivity were forced at those grids located above the mixing height.

b. Numerical methods

A second order, central finite difference scheme was used to integrate the advection and horizontal terms and the Crank Nicholson method was used for the vertical diffusion term. Since the concentration fields usually have large variations, phase errors resulting from the finite difference method are large. Therefore, careful treatment is required. The finite difference approximation to the concentration equation is

$$\begin{aligned} C^{n+1}_{ijk} = C^n_{ijk} + \mathfrak{U}[C^n_{ijk}] + \mathfrak{V}[C^n_{ijk}] + \mathfrak{W}[C^n_{ijk}] \\ + D_{xy}[C^n_{ijk}] + D_z[C^{n+1}_{ijk}] + \Delta t Q_{ijk}/\Delta V - \Delta t k_a C^n_{ijk}, \quad (17) \end{aligned}$$

where $\Delta V = \Delta x \Delta y \Delta z$ is the grid volume; $\mathfrak{U}$, $\mathfrak{V}$, $\mathfrak{W}$ are finite-difference operators for horizontal and vertical advection, and D_{xy}, D_z for horizontal and vertical diffusion; n is the time step index; and i, j, k are grid indexes along the x, y, z directions, respectively.

The operators $\mathfrak{U}$, $\mathfrak{V}$ and $\mathfrak{W}$ are defined by

$$\left.\begin{aligned}\mathfrak{U}[C_{ijk}]&=F_x[C_{ijk}]-F_x^*[C_{ijk}]\\ \mathfrak{V}[C_{ijk}]&=F_y[C_{ijk}]-F_y^*[C_{ijk}]\\ \mathfrak{W}[C_{ijk}]&=F_z[C_{ijk}]-F_z^*[C_{ijk}]\end{aligned}\right\},$$

where

$$F_x[C_{ijk}]=\frac{\alpha_{xi}}{(1+r_{xi})}[(1+\alpha_{xi})C_{i-1,jk}+(1-\alpha_{xi})C_{ijk}], \quad (18a)$$

$$F_x^*[C_{ijk}]=\frac{\alpha_{xi}^* r_{xi}}{(1+r_{xi})}[(1+\alpha_{xi}^*)C_{ijk}+(1-\alpha_{xi}^*)C_{i+1,jk}], \quad (18b)$$

$$r_{xi}=(\Delta x_i/\Delta x_{i-1})\alpha_{xi}=\Delta t U_{i-\frac{1}{2},jk}/\Delta x_{i-1}, \quad (18c)$$

$$\alpha_{xi}^*=\Delta t U_{i+\frac{1}{2},jk}/\Delta x_i.$$

The similar expressions for F_y and F_y^* can be obtained by interchanging the index i by j in (18). Similarly, for F_z and F_z^*, we replace x and changes of i by z and k respectively. Eqs. (18) apply to non-uniform grid spacings. Since grid space is uniform in the x and y directions, $\Delta x_i=\Delta x$, $\Delta y_j=\Delta y$, $r_{xi}=1$ and $r_{yj}=1$. The time-splitting method was employed in which the new values of C calculated from $\mathfrak{U}$ operator are used for $\mathfrak{V}$ operator. Thus

$$\left.\begin{aligned}\overset{*}{C}_{ijk}&=\overset{n}{C}_{ijk}+\mathfrak{U}[\overset{n}{C}_{ijk}]\\ \overset{**}{C}_{ijk}&=\overset{*}{C}_{ijk}+\mathfrak{V}[\overset{*}{C}_{ijk}]\end{aligned}\right\}.$$

Since the distributions of C are not smooth, a special treatment is required to prevent the truncation error from amplifying. The following simple method was used:

$$F_x=\begin{cases}C_{ijk}, & \text{if } \alpha_{xi}<0,\ C_{ijk}<-F_x\\ C_{i-1,jk}, & \text{if } \alpha_{xi}>0,\ C_{i-1,jk}<F_x\end{cases} \quad (19a)$$

$$F_x^*=\begin{cases}C_{ijk}, & \text{if } \alpha_{xi}^*>0,\ C_{ijk}<F_x^*\\ C_{i+1,jk}, & \text{if } \alpha_{xi}^*<0,\ C_{i+1,jk}<-F_x^*\end{cases} \quad (19b)$$

Similar treatment is also applied to F_y, F_y^*, F_z and F_z^*. This method can preserve the amount of concentration when it is transported from one grid to the next. In addition, it can prevent the values of concentration from becoming negative due to truncation errors. The operators D_{xy} and D_z are defined by

$$D_{xy}[C_{ijk}]=\Delta t K_H[(C_{i-1,jk}-2C_{ijk}+C_{i+1,jk})/\Delta x^2 + (C_{i,j-1,k}-2C_{ijk}+C_{i,j+1,k})/\Delta y^2], \quad (20)$$

$$D_z[C_{ijk}^{n+1}]=\gamma_k(\theta D[C_{ijk}^{n+1}]+(1-\theta)D[C_{ijk}^{n}]), \quad (21)$$

where

$$D[C_{ijk}]=r_k K_{k-\frac{1}{2}}[C_{ij,k-1}-(r_k K_{k-\frac{1}{2}}+K_{k+\frac{1}{2}})C_{ijk} + K_{k+\frac{1}{2}}C_{ij,k+1}],$$

$$\gamma_k=\Delta t/[\Delta z_k(\Delta z_k+\Delta z_{k-1})],$$

$$r_k=\Delta z_k/\Delta z_{k-1},$$

and θ is a parametric constant.

The stability criteria for the terms of advection, horizontal and chemical reaction rate are well known (Ritchmyer and Morton, 1967) as

$\alpha_a, \alpha_a^*<1$, where subscript a denotes x, y, or z,
$\Delta t K_H/(\Delta x^2+\Delta y^2)<\frac{1}{4}$, and $\Delta t k_a\leq 1$.

The stability criterion for the vertical diffusion term for uniform Δz and K is

$$K\gamma_k\begin{cases}\leq \dfrac{1}{4(1-2\theta)}, & \text{for } \theta\leq 1/2\\ >0, & \text{for } \theta>1/2\end{cases} \quad (22)$$

This stability condition simply says that the implicit scheme used in (21) is unconditionally stable when $\theta\geq\frac{1}{2}$. However, it cannot prevent amplification of truncation errors when the concentration fields are not smooth and the value of γ_k is large. The present study indicates that another additional condition is required. When the diffusion takes place between two grid boxes, the flux across the boundary is proportional to $-K\partial C/\partial z$. The flux will cease when the gradient approaches zero. Thus, we have

$$(C_{ijk}^{n+1}-C_{ij,k+1}^{n+1})/(C_{ijk}^{n}-C_{ij,k+1}^{n})\geq 0.$$

This requirement leads to the condition

$$K_{k+\frac{1}{2}}\gamma_k\leq\frac{1}{4(1-\theta)}. \quad (23)$$

Hence, the value of θ must be close to 1, if a large value of γ_k is used. Eq. (17) applies to a constant grid spacing system. When the grid space is a function of time, a correction due to the changing volume is needed. It can be shown that $-C_{ijk}\partial\ln\Delta z_k/\partial t$ should be added on the right-hand side of Eq. (17). The implementation of this correction is simplified by changing the height $H(t)$ for each hourly period. With this arrangement, the concentrations at the upper five grid points are adjusted hourly according to the height H as follows:

$$C_{ijk}^{n+1}=\begin{cases}C_{ijk}^{n}s_n, & k\geq 11\\ \left(\dfrac{1+r_k s_n}{1+r_k}\right)C_{ijk}^{n}, & k=10\end{cases}$$

where $s_n=(H^{n+1}-z_{10})/(H^n-z_{10})$.

5. Results and discussions

The period from 1–26 February 1965 was chosen for these model computations. During these 25 consecutive days, various meteorological conditions occurred which allow evaluation of the generality and performance of the model. The computer time for this computation is 2.5 min for every 24 hr simulation on IBM system 360/195.

a. General assessment

The period-average concentration for 25 days at ten monitoring stations (indicated by station number) are shown in Fig. 3. Both measured values from 2-hr and 24-hr instruments are used for comparison. The 2-hr data are consistently larger than the 24-hr data. The agreement between computed and measured values is very good. The correlation coefficient is 0.899 and 0.873 for 2- and 24-hr data, respectively. Excellent agreement can be seen for stations 15, 28, 33, 36, fair for stations 3, 4, 12, 17, and poor for station 10. The three-month average results from the Gaussian plume model (Pelton *et al.*, 1972) are also shown. The present results for shorter averaging period (25 days) are better than those from the Gaussian model which yields the correlation coefficient of 0.675 based on the regression line. Interestingly enough, the stations where two models either overestimate (stations 3, 12, 23) or underestimate (stations 4, 15, 17, 10) are consistent. The underestimation at station 10 may be due to the influence of nearby large stacks which contributed to local high concentration values. Such strong local variations cannot be resolved with the present grid model. The stations (4, 15, 17) where the model underestimated concentration values are located on the northwestern part of the urban area. On the other hand, concentration at those stations located on the southeastern side of the city were overestimated by the model computations. This geographical dependence of model performances (including Gaussian plume model) indicates that further study is warranted.

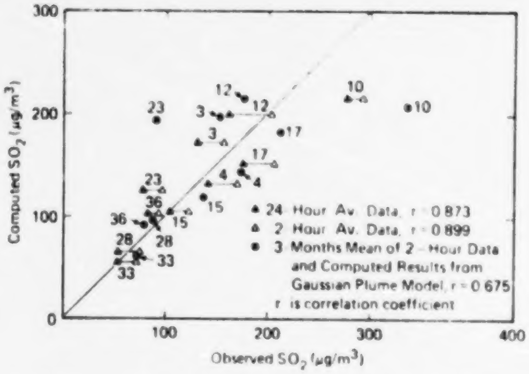

FIG. 3. Comparison of observed and computed 25-day averaged SO_2 concentration values (1-26 February 1965).

These phenomena may be due to the urban heat island effect which was not properly accounted for in the model. Since the prevailing wind during this period was from the northwest, the underestimated concen-

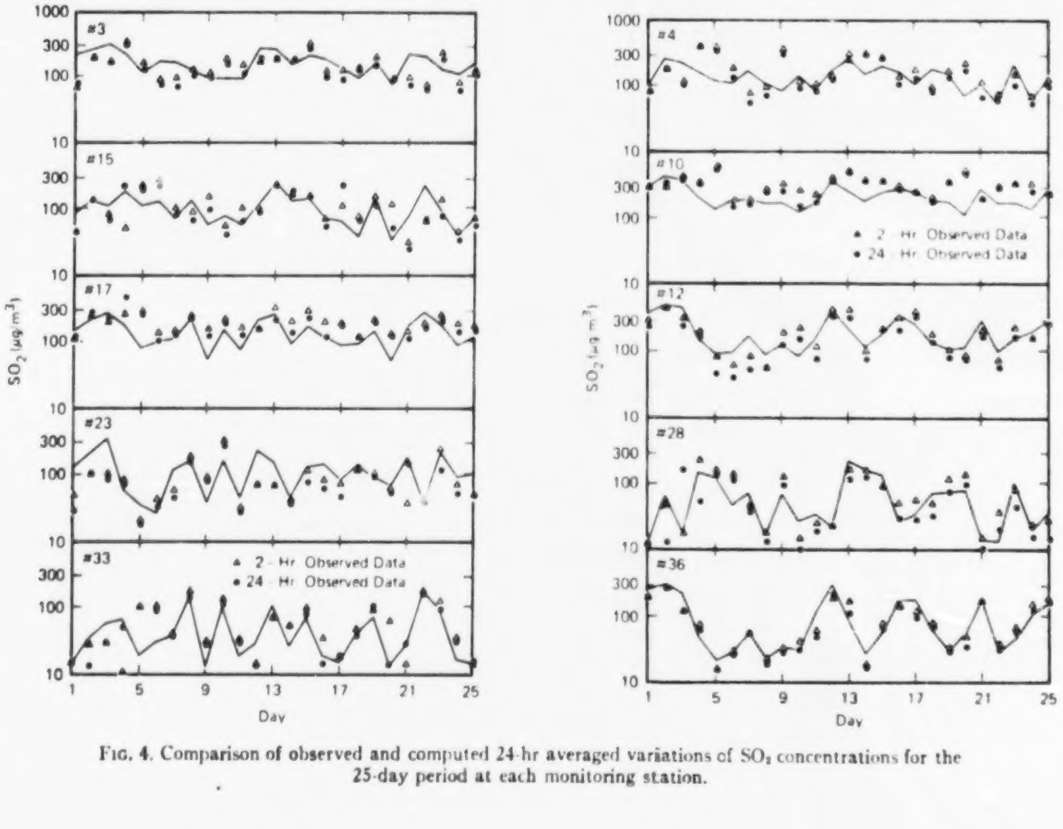

FIG. 4. Comparison of observed and computed 24-hr averaged variations of SO_2 concentrations for the 25-day period at each monitoring station.

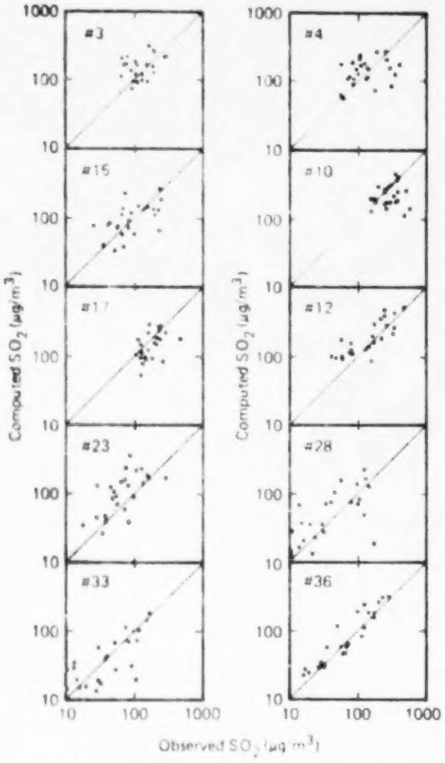

FIG. 5. Comparison of observed and computed 24-hr averaged SO$_2$ concentration values at each monitoring station.

tration values are at stations upwind of the central urban area and the overestimated values at stations downwind of the urban area. The internal turbulent boundary layer can form when the surface conditions are altered by roughness or temperature changes (Shir, 1972b). This feature has not been included in the present study which essentially assumes the turbulent flows are in equilibrium with the surface conditions. As a consequence, the eddy diffusivity estimated at the upwind edge is too large and that estimated at the downwind edge too small. The result of this assumption leads to concentration underestimates upwind of the urban area and overestimate downwind. More complicated effects due to the urban heat island, such as convection and non uniform spatial stability, may also affect this discrepancy. However, effects on the stations which are far away from the central area are less. This can be seen in the good agreement of the observed data vs simulated values at stations 28, 33 and 36.

b. 24-hr averaged concentrations

Fig. 4 shows the 24-hr averaged time variation of the computed and observed concentration values. The observed values include 24-hr and 2-hr sampling data, the former being lower than the latter. This discrepancy makes comparison very difficult. The computed 24-hr mean concentrations shown in Fig. 4 follow the trend of the observed data. The agreement between the computed and observed data is very good at stations 36, 28, 12 and 33. The model computations underestimated the concentrations on the 4th, 5th, 9th, 14th and 20th of the month. This may be due to underestimated emission rates from the emission inventory model. The days on which overestimates occurred at stations 3 and 23 are for the northwest wind condition. The wind direction results in pollutant concentration being transported from large upwind emission sources. However, the transport effects do not show up on the observed data at stations 3 and 23 which are dominated by the local emission rates. This raises some doubts both in the model computation and the representation of the station data. The street canyon effects of high-rise buildings may prevent upwind concentrations from reaching the station. This causes strong local influences on the observed data. The strong microscale variations are even more pronounced for automobile exhaust. Hence the selections of station sites and the real representation of the observed data are quite important. On the other hand, the computed results can only represent mean concentration over a grid size which neglects microscale variations within that grid. The detailed microscale concentration distribution can only be resolved with a subgrid model such as that of Johnson *et al.* (1970). Such a subsystem for this model requires further developments. The excellent results at stations 36, 28 and 33 are apparently free from the effects of horizontal inhomogeneity and local influences, since these stations are located in relatively low emission areas far from the central region. The concentrations at these stations vary by two orders of magnitude depending on wind direction. These large concentration fluctuations are due to advection and are reproduced quite well by the model. The two sets of measured data, *viz.* 2- and 24-hr data, are also shown in Fig. 4. The 24-hr data are usually lower than the 2-hr data. On the 4th, 20th and 21st, the computed values at station 33 agree well with

TABLE 2. Correlation coefficients of computed vs observed 24-h averaged SO$_2$ concentrations.

Station no.	Objective analyzed wind field		Turner's analyzed wind field	
	Linear scale	Log scale	Linear scale	Log scale
3	0.380	0.334	0.398	0.325
15	0.617	0.598	0.635	0.620
17	0.363	0.466	0.408	0.502
23	0.471	0.647	0.444	0.642
33	0.832	0.725	0.830	0.718
4	0.177	0.284	0.220	0.313
10	0.139	0.145	0.105	0.125
12	0.830	0.821	0.812	0.804
28	0.828	0.886	0.823	0.878
36	0.914	0.910	0.937	0.940
Total	0.654	0.806	0.659	0.809

the 24-hr data but not the 2-hr data. Conversely, for the 2nd, 3rd and 4th, the computed values at station 28, agree well with the 2-hr data but not the 24-hr data. However, these two data sets agree well with each other and with computed results at station 36. Hence, no conclusion can be made as to which of the two data sets is more representative of the concentration distribution.

The scatter diagrams of computed values vs observed data for ten stations are shown in Fig. 5. The model performed very well at stations 36, 28, 12 and 33, whereas it underestimated concentration at station 4, 10 and 17, and overestimated at stations 3 and 23. In total, 84% of the results are within a factor of 2 of the observed 24-hr data. Discarding those observed data which have large discrepancies between 2- and 24-hr sampling values raises the score to 88%. The results seem to be compatible with present knowledge and available input data. The correlation coefficients between the computed values and the observed data are 0.806 in log scale and 0.654 in linear scale (Table 2). The computations based on Turner's analyzed wind field yielded slightly better results. Since the observed data distributions are usually log-normal, the correlation coefficient in log scale may be more meaningful than that in linear scale.

c. Temporal variations of 2-hr averaged concentrations

The 2-hr average results are shown in Fig. 6. Results are good at stations 36, 28 and 12, and fair at the other stations. Again, the concentrations are underestimated at stations 4, 10 and 17. The time variation of observed 2-hr averaged concentrations shows greater variation than the measured 24-hr data. This is especially true at stations 23, 33, 12, 28 and 36. It is generally very difficult to simulate a concentration field which varies widely over a short period of time. In the past, this has limited the use of models for simulating short-term pollution concentrations. However, the computed

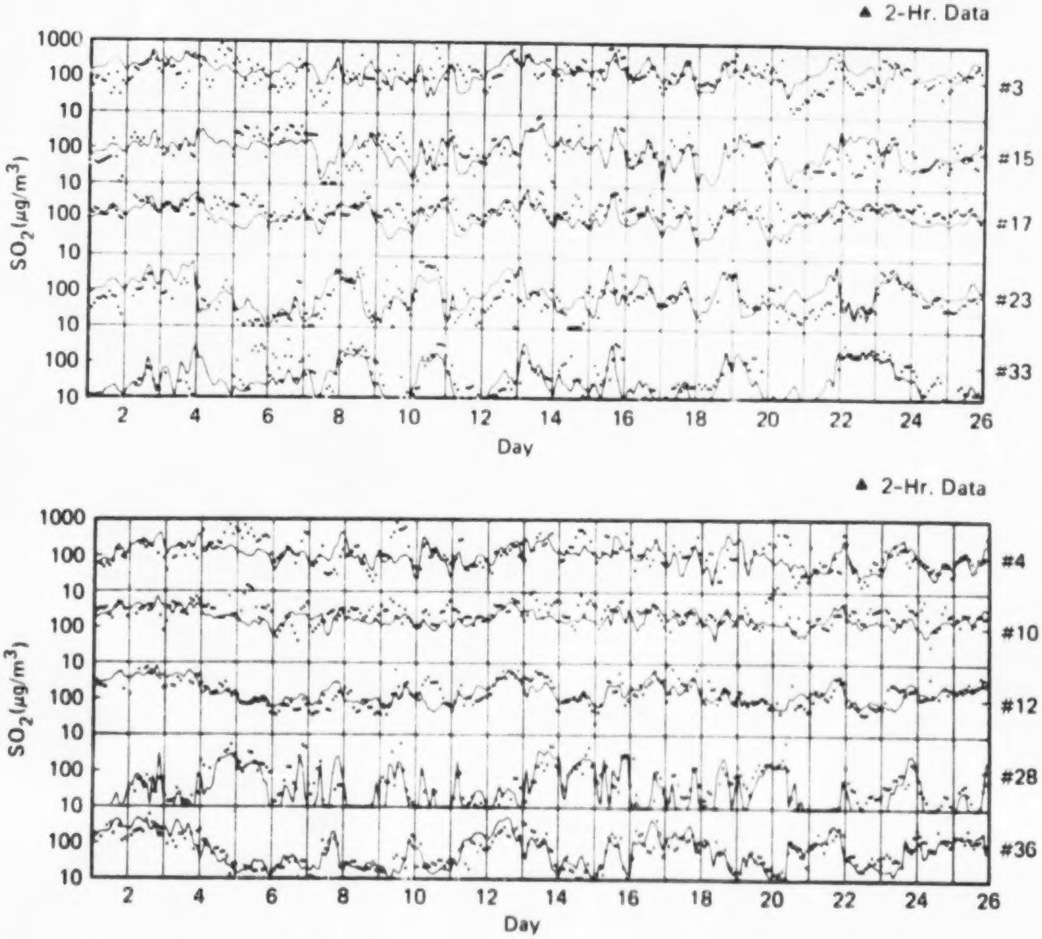

Fig. 6. Comparison of observed and computed 2-hr averaged SO_2 concentration values at each monitoring station.

TABLE 3. Correlation coefficients of computed vs observed 2-hr averaged SO_2 concentrations.

Station no.	Numbers of cases	Objective analyzed wind field		Turner's analyzed wind field	
		Linear scale	Log scale	Linear scale	Log scale
3	295	0.328	0.322	0.301	0.295
15	232	0.485	0.443	0.479	0.444
17	290	0.440	0.459	0.425	0.450
23	267	0.486	0.591	0.468	0.584
33	235	0.588	0.680	0.586	0.677
4	268	0.187	0.438	0.195	0.435
10	281	0.230	0.250	0.231	0.247
12	275	0.648	0.686	0.629	0.663
28	282	0.639	0.730	0.626	0.732
36	286	0.617	0.769	0.605	0.782
Total	2711	0.531	0.706	0.525	0.704

results of this model, e.g., stations 36, 28 and 12, follow closely the trend of observed data, although the observed data do show a highly fluctuating pattern. Hence, the use of this model for short term pollution prediction is feasible.

For northwest wind conditions which occurred on the 1st, 3rd, 7th, 12th, 16th, 21st and 25th, the model underestimated the concentration at stations 3 and 23. As has been previously mentioned, the advection effects on the concentration do not appear on the observed data. Similar underestimated results occurred for the south wind conditions at most of the stations for the 5th, 6th, 9th, 14th and 19th days. It was found that high temperatures are associated with these days. The cause of underestimated results on these days is not completely clear. However, south wind conditions during our simulation period generally follow warm front passages. During such passage, emission may be underestimated due to unseasonable warm air. Also, the air motion and atmospheric stability are more complicated than has been specified in the model. Quite often, the computed trends have a phase shift from the observed data whenever air temperatures change rapidly. This indicates that the emission rates may have a certain time lag when responding to air temperature changes. The exact duration of the time lag seems to be quite complex and requires further investigation.

In general, the trend pattern of computed values follows reasonably close to that of the observed data. This is an important consideration on the feasibility of the model for short-term pollution prediction.

A few of the peak concentrations which appear on certain stations in Fig. 6 are mainly due to the influences of the large industrial sources near Alton, located 30 km north of St. Louis. These occur under north wind conditions. This phenomenon is strongly evident on 3 and 16 February, on the morning of 19 February at 22 stations, and somewhat weakly at noon on 4 and all February, and on the morning of 24 February at east-side (even number) stations. Thus, those large industrial sources contribute significantly to concentrations under this wind condition.

The correlation coefficients between the computed values and the observed data at ten stations are shown in Table 3. The correlation for all 10 stations is 0.531 in linear scale and 0.706 in log scale. The correlation based on Turner's analyzed wind field, which is also shown on Table 3, is very close to that based on objective analyzed wind. This is a 52% improvement from the Gaussian plume model which has a correlation of 0.347 based on regression line.

d. The frequency distribution of concentrations

The frequency distributions of combined 2-hr data at nine stations (excluding station 10) for different wind directions are shown in Fig. 7. The agreement is excellent for NE and SE wind directions. The maximum discrepancy in the concentration values between the 20 and 80 percentiles is 10 and 20 $\mu g\ m^{-3}$ for NE and SE wind conditions, respectively. The computed results overestimated the concentrations for NW winds and underestimated them for SW winds. These discrepancies

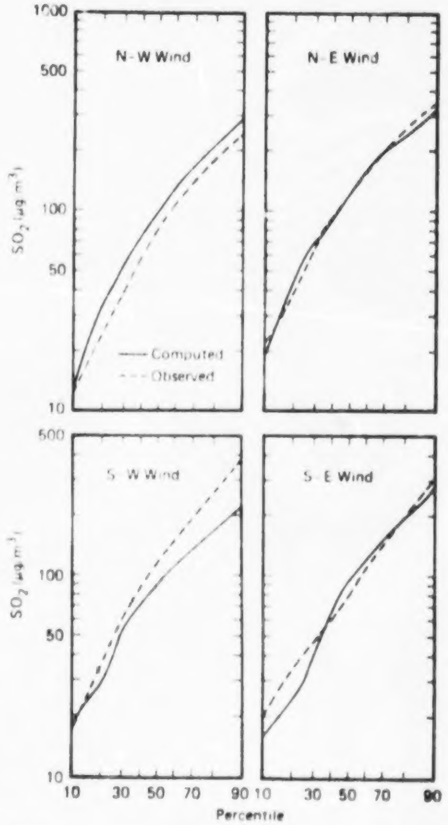

FIG. 7. Comparison of observed and computed 2-hr averaged frequency distribution of SO_2 concentration according to wind sectors (combined data from nine stations).

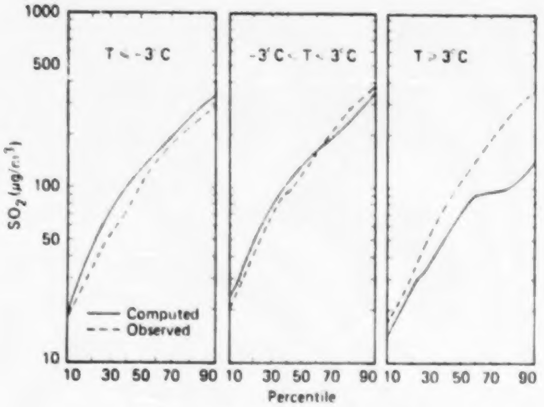

FIG. 8. As in Fig. 7 except for classification according to temperature range.

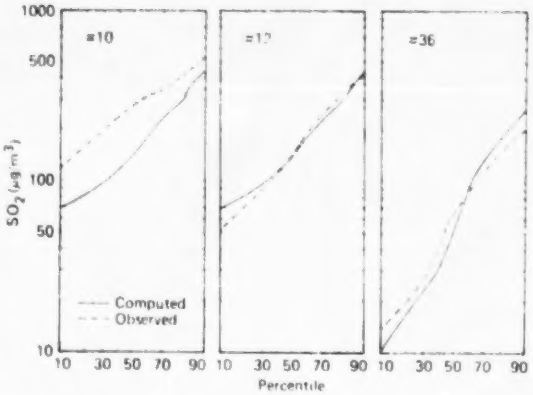

FIG. 9. Comparison of observed and computed 2-hr average frequency distributions of SO$_2$ concentration for three stations.

are consistent with the previous discussion. Since NW and SW winds often carry cold and warm air, respectively, these discrepancies may well be due to lag response of the emission rates to changing air temperatures.

This can be seen more clearly from Fig. 8 in which the frequency distributions for different temperature ranges are shown. The agreement is good when the air temperatures are between −3C and 3C. Overestimation and underestimation are seen when the temperatures are lower than −3C and higher than 3C, respectively.

Fig. 9 shows the frequency distributions at stations 10, 12 and 36, with good agreement at stations 12 and 36, and large underestimates at station 10 due to its proximity to point sources. The performance of the model at all ten stations is consistent with respect to the different statistical analyses. This reveals the possibilities of further improvements.

e. Spatial distributions of surface concentrations

In Fig. 10, we present a series of noteworthy cases which show the distribution of surface SO$_2$ concentrations under the specified conditions. A summary of these cases is given in Table 4.

Fig. 10a shows the surface SO$_2$ concentration field for a typical west wind condition in the St. Louis area. Atmosphere stability is nearly neutral. On this day (2 February 1965), the meteorological conditions were quite persistent. The source emission pattern is distinctly marked by the morning and evening hour peak concentrations, as reported by most of the stations (see Fig. 6), and simulated by the model. This figure shows the concentration field during the morning hour peak. The distribution pattern clearly indicates that there are four major axes of local maximum concentrations. These local high concentrations were resulted from the strong source emissions in the area of Alton, Granite City, East St. Louis and south St. Louis. The significant contributions of these sources to the surface concentrations can also be seen from the rest of the Figs. (10b 10i). The elongation of the closed isopleths is parallel to the mean wind direction. The local Alton area maximum (northeast of St. Louis) shows a simpler pattern than in the St. Louis and East St. Louis areas.

TABLE 4. Summary of various parameters used in the simulation of SO$_2$ concentrations shown in Figs. 10 and 11.*

Fig. no.	Day/Hour**	dd	ff	S	H	Q_A	Q_P	T	Remarks
10a	2/8	289	4.9	0.3	500	88547	10838	−16	typical west wind
10b	25/10	296	9.8	0	773	8140	11825	−12	high west wind
10c	13/4	302	2.2	1.9	710	4593	7123	−4	low west wind and stable atmosphere
10d	9/2	76	4.0	0.6	270	2732	6023	2	east wind
10e	8/14	19	4.0	−0.7	813	4835	10256	0	northeast wind, effects of emission sources at Alton area
10f	22/12	274	2.7	−1.8	942	6249	10899	−7	rotating wind, unstable atmosphere
10g	13/18	72	4.5	0.4	1000	4149	9332	0	rotating wind, stable atmosphere
10h	7/24	189	3.1	0.4	369	2115	6293	12	southwest wind, before cold front passage
10i	8/2	354	5.8	0.1	300	1682	6161	7	after cold front passage
11a	2/19	292	4.9	0.25	540	8570	12102	−15	typical west wind
11b	13/3	302	2.2	2.2	700	4593	7123	−4	
11c	3/8	358	3.1	0.3	400	7530	10517	−10	north wind

* dd, wind direction in degrees; ff, wind speed (m sec^{-1}); S, stability index; H, mixing height (m); Q_A, area source strength (gm sec^{-1}); Q_P, point source strength (gm sec^{-1}); T, temperature (°C).

** February 1965/LST.

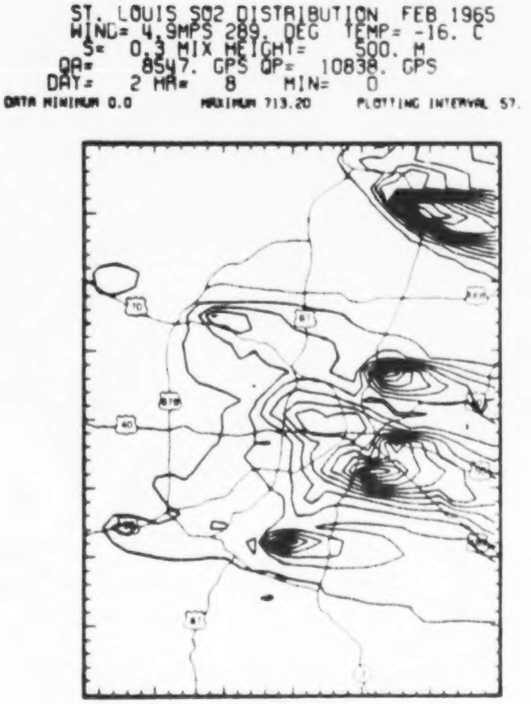
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 4.9MPS 289. DEG TEMP= -16. C
S= 0.3 MIX HEIGHT= 500. M
QA= 8547. GPS QP= 10838. GPS
DAY= 2 HR= 8 MIN= 0
DATA MINIMUM 0.0
MAXIMUM 713.20
PLOTTING INTERVAL 57.

FIG. 10a. Simulation of 2 hr average surface SO_2 concentration field.

The effect of multiple emissions in the central urban area is prominent. The effect of wind speed on the pattern of the surface SO_2 concentration field is shown in Fig. 10b. The total source emission and the atmospheric stability are nearly the same as in the previous case. The increase in the wind speed results in a somewhat similar but simpler distribution pattern. The surface concentrations in the central area are reduced by about half, with the wind speed doubled from the previous case. This might suggest that the surface concentrations in the central area are approximately inversely proportional to the wind speed under the same prevailing meteorological conditions. However, as will be seen later, it is not that simple. The surface concentrations near Alton, where the point sources are dominant, are only reduced by 30%. This may be due to different plume rise: the increase of wind speed decreases the plume rise which in turn increases the surface concentrations. This phenomenon can be seen more clearly in Fig. 10c which shows the concentration pattern under low winds and a stable atmosphere. Although the total source emission is about 60% of that in the previous cases, the concentration pattern is quite different. The surface concentrations near Alton are largely reduced. There are two reasons for this: large plume rise due to low wind speed; and weak diffusive mixing, due to the stable atmosphere, which causes SO_2 to reach the ground slowly. The same reasons also explain the

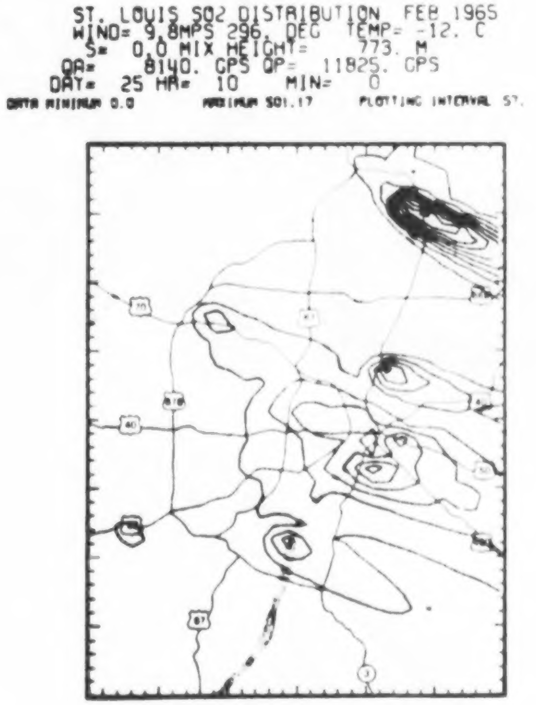
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 9.8MPS 296. DEG TEMP= -12. C
S= 0.0 MIX HEIGHT= 773. M
QA= 8140. GPS QP= 11825. GPS
DAY= 25 HR= 10 MIN= 0
DATA MINIMUM 0.0
MAXIMUM 501.17
PLOTTING INTERVAL 57.

FIG. 10b. Simulation of 2 hr average surface SO_2 concentration field

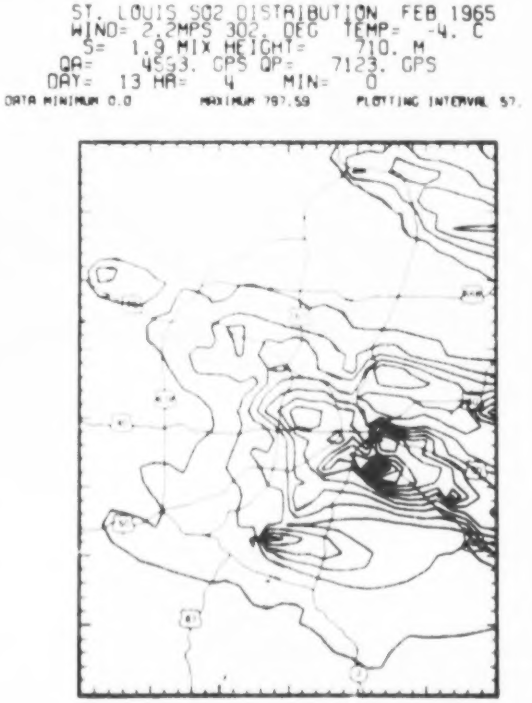
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 2.2MPS 302. DEG TEMP= -4. C
S= 1.9 MIX HEIGHT= 710. M
QA= 4553. GPS QP= 7123. GPS
DAY= 13 HR= 4 MIN= 0
DATA MINIMUM 0.0
MAXIMUM 787.59
PLOTTING INTERVAL 57.

FIG. 10c. Simulation of 2 hr average surface SO_2 concentration field.

diminution of the local high concentration near Granite City. The local maximum concentration still occurs at East St. Louis, but is displaced somewhat eastward. The concentration levels at both St. Louis and East St. Louis are of equivalent intensity as in the 2 February case (Fig. 10a) even though source emissions have been reduced 60%. From these three figures (10a–c), as has been discussed, there is no simple relation between the surface concentrations and the local source-wind ratio, $Q/\bar{u}$, in these areas under the same wind direction. Thus, even under the same persistent wind direction, the variation of the wind speed can alter the concentration pattern significantly.

We now investigate the effects of the wind direction upon the concentration distributions. The next four figures show the different concentration patterns which result from various component winds; that for an east wind is given in Fig. 10d. The four major local maxima appear clearly (as in the west-wind pattern of Fig. 10a), except that the locations of the maxima are shifted westward. This figure clearly demonstrates that the variations of wind direction can change the concentration pattern completely. Thus, as has been discussed already, the concentration distributions are greatly influenced by atmospheric stability, wind speed and direction orientation with respect to the source distributions. Moreover, the concentrations in the downtown

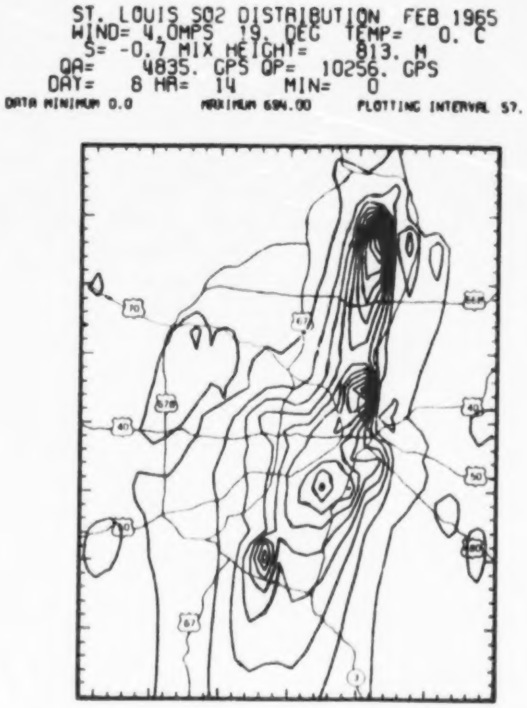
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 4.0MPS 19. DEG TEMP= 0. C
S= -0.7 MIX HEIGHT= 813. M
QA= 4835. GPS QP= 10256. GPS
DAY= 8 HR= 14 MIN= 0
DATA MINIMUM 0.0 MAXIMUM 694.00 PLOTTING INTERVAL 57.
70
67
40
50
3

Fig. 10e. Simulation of 2-hr average surface SO_2 concentration field.

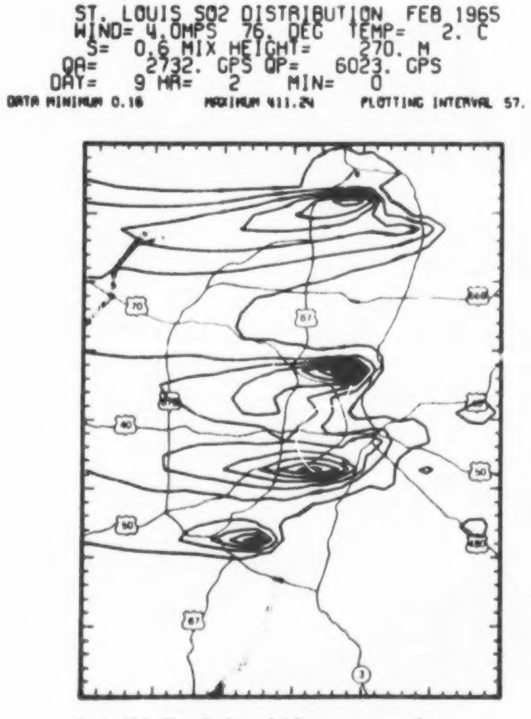
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 4.0MPS 76. DEG TEMP= 2. C
S= 0.6 MIX HEIGHT= 270. M
QA= 2732. GPS QP= 6023. GPS
DAY= 9 HR= 2 MIN= 0
DATA MINIMUM 0.16 MAXIMUM 411.24 PLOTTING INTERVAL 57.
70
67
40
50
3

Fig. 10d. Simulation of 2-hr average surface SO_2 concentration field.

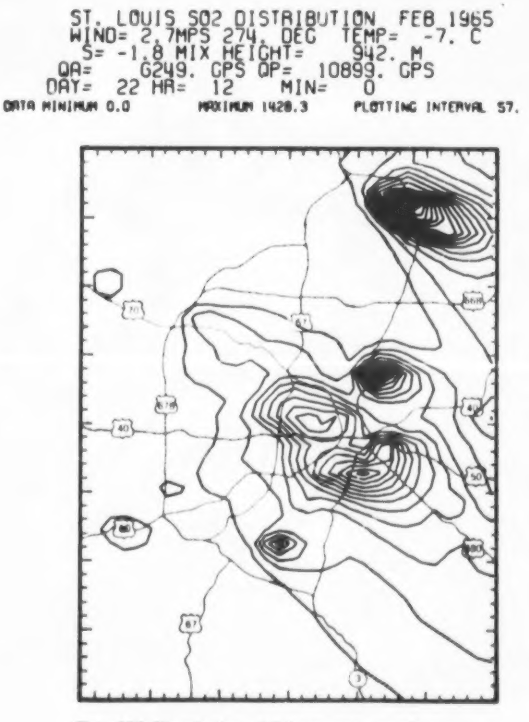
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 2.7MPS 274. DEG TEMP= -7. C
S= -1.8 MIX HEIGHT= 942. M
QA= 6249. GPS QP= 10899. GPS
DAY= 22 HR= 12 MIN= 0
DATA MINIMUM 0.0 MAXIMUM 1428.3 PLOTTING INTERVAL 57.
70
67
40
50
3

Fig. 10f. Simulation of 2-hr average surface SO_2 concentration field.

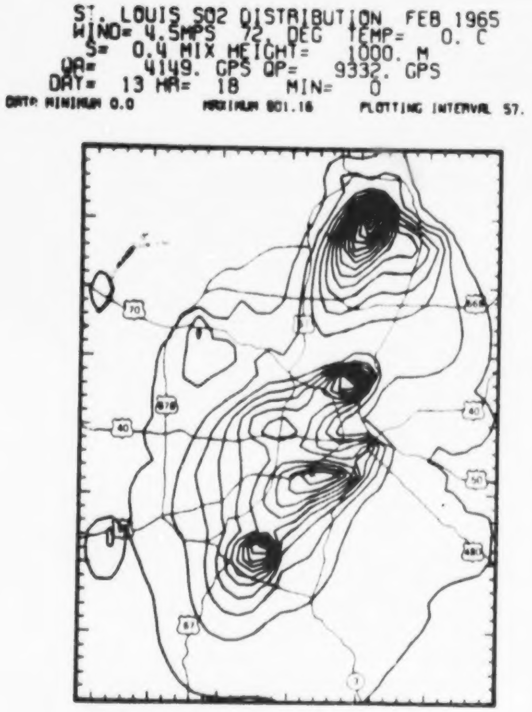
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 4.5MPS 72. DEG TEMP= 0. C
S= 0.4 MIX HEIGHT= 1000. M
QA= 4149. GPS QP= 9332. GPS
DAY= 13 HR= 18 MIN= 0
DATA MINIMUM 0.0 MAXIMUM 801.16 PLOTTING INTERVAL 57.
70
40
67
3
40
50

Fig. 10g. Simulation of 2-hr average surface SO_2 concentration field.

St. Louis area usually have greater values during easterly than during westerly winds.

A case of no morning and evening peak concentrations was reported on 8 February. Instead, a single peak concentration appears at noon (Fig. 6). This phenomenon is more pronounced for the station located on the west side of the Mississippi River; the concentration field is reproduced in Fig. 10e. Throughout this day, the wind speed and source emission rate were held quite constant, and the temporal variation in stability was also small. The reason for this single peak concentration in the daily variation can be attributed to two factors. One is the rotation of wind direction from NW in the morning to NE at noon. This tends to make pollutants in the air remain in the urban area. The major contributing factor was that the pollutants emitted from the industrial area (located at Alton) were transported to the metropolitan center. For all wind directions, downtown St. Louis has the highest concentration values under the northeast winds. Fig. 10e clearly explains the reason. The contribution of industrial emissions to the concentration in the metropolitan area were also reported for 3 February. However, during this day, the wind changed direction from west to north, then back to west in the morning and repeated the same pattern in the afternoon. The north wind condition coincided with morning and evening peak source emissions. The observed concentration

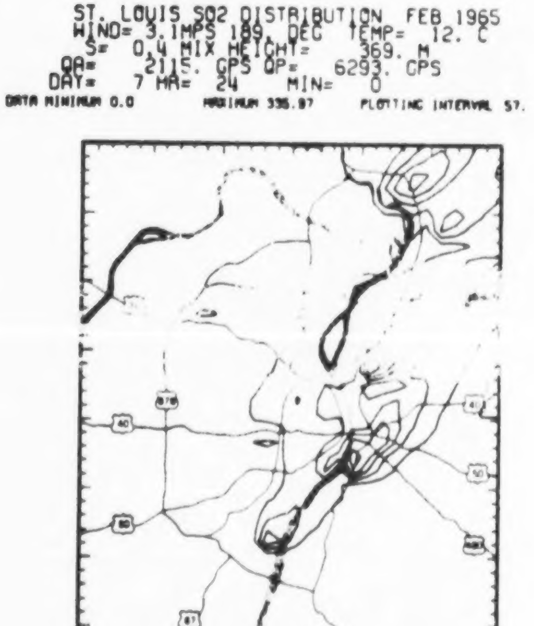
ST. LOUIS SO2 DISTRIBUTION FEB 1965
WIND= 3.1MPS 189. DEG TEMP= 12. C
S= 0.4 MIX HEIGHT= 369. M
QA= 2115. GPS QP= 6293. GPS
DAY= 7 HR= 24 MIN= 0
DATA MINIMUM 0.0 MAXIMUM 335.87 PLOTTING INTERVAL 57.
40
50
40
50
67
3

Fig. 10h. Simulation of 2-hr average surface SO_2 concentration field.

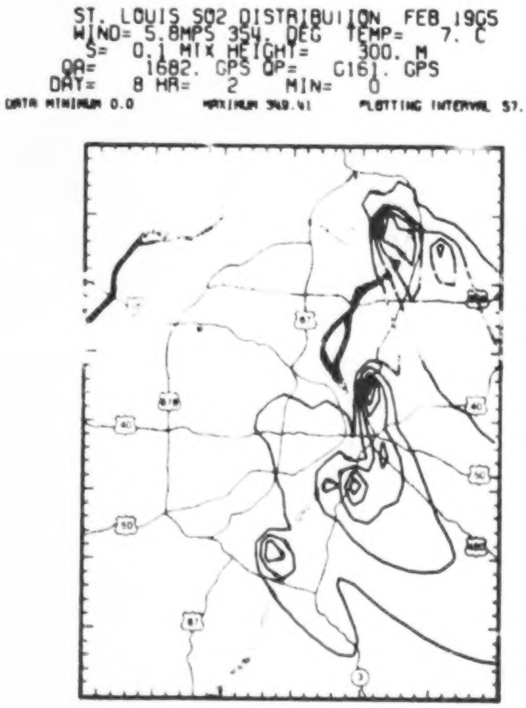
ST. LOUIS SO2 DISTRIBUITION FEB 19G5
WIND= 5.8MPS 354. DEG TEMP= 7. C
S= 0.1 MIX HEIGHT= 300. M
QA= 1682. GPS QP= C161. GPS
DAY= 8 HR= 2 MIN= 0
DATA MINIMUM 0.0 MAXIMUM 349.41 PLOTTING INTERVAL 57.
67
40
40
50
50
67
3

Fig. 10i. Simulation of 2-hr average surface SO_2 concentration field.

values at most stations showed sharp peaks during these hours.

Low wind speeds associated with a rapidly rotating wind direction will have the effect of distributing pollutants in a more circular pattern. This happened on 13 and 22 February. On these two days the wind changed direction more than 180° in a very short period; the resulting circular trajectory of the air had a dramatic effect on the transport of the pollutants in the atmosphere. This is illustrated in Figs. 10f and 10g for 22 and 13 February, respectively. The former is for an unstable atmosphere and the latter for a slightly stable atmosphere. Apparently, atmospheric stability has little effect on the distribution pattern when the wind direction is changing rapidly. However, one still can notice the effect of final wind direction on these two figures. Our experience indicates that a steady-state model is not able to reproduce the resultant concentration fields shown in Figs. 10f and 10g. It should be noted that concentration values show a great temporal variation from one station to another due to the orientation of source-receptor locations and its relationship with respect to wind direction. In some cases, a different trend is reported [e.g., stations 28 and 36 on 22 February (Fig. 6)]. The comparison of computed concentrations and observed data during these periods is remarkable. This indicates that model computation is able to respond to fast changing atmospheric conditions. Thus, the concentration distributions also depend on the history of the wind.

A cold front passed the St. Louis Metropolitan area at 2400 LST 7 February. Figs. 10h and 10i show the concentration fields before and after the frontal passage, respectively. In a 2-hr period, the wind changed its direction from southwest to northwest and picked up speed. In the same period the ambient temperature dropped from 12 to 7C, and eventually reached 0C. All stations reported a sharp decrease in concentration during this period followed by rapid increase after frontal passage (Fig. 6). The model is able to predict this trend pattern. However, there is a slight time lag in the observed minimum as compared with the computed value. The reason is quite complicated. We tend to agree that the disparity between the analyzed and actual wind fields probably is a contributing factor. Fig. 10h also represents a typical concentration field for the St. Louis area under southwest winds.

f. Vertical distributions of concentrations

Very few up-to-date investigations have been made to understand the vertical distribution of pollutants in an urban atmosphere. While our model computes the three-dimensional distributions of SO_2 concentration, unfortunately, there are no observational data to verify its results. The following discussions are some phenomenological conclusions indicated by the computational results.

Figs. 11a–c show vertical cross sections (x–z plane) of SO_2 concentrations.

The chosen cross section which is located 19 source grids from the bottom (see Fig. 1) passes through downtown St. Louis. A summary of these cases is included in Table 4. Fig. 11a represents the vertical concentration pattern parallel to the wind for medium-strength west winds and an unstable atmosphere. Two distinct concentration maxima occurred east of the St. Louis and East St. Louis areas. Large amounts of SO_2 were dispersed up to the mixing height due to high turbulent mixing under unstable conditions. The slopes of the isopleths at downtown St. Louis are larger than those at rural areas due to large urban roughness. The high concentration and large slopes of the isopleths at East St. Louis were caused by the elevated industrial sources. Fig. 11b is for a case of low west winds with a stable atmosphere. Even with lower winds the slopes of the isopleths are much smaller than those in the previous

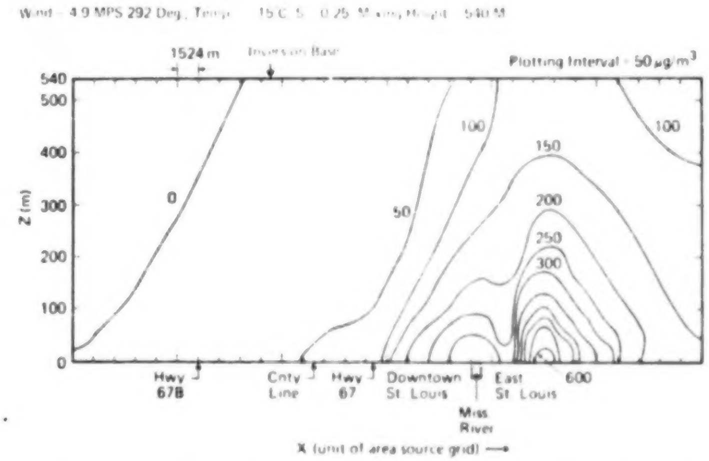

FIG. 11a. Simulation of hourly averaged SO_2 concentration field in the x-z plane.

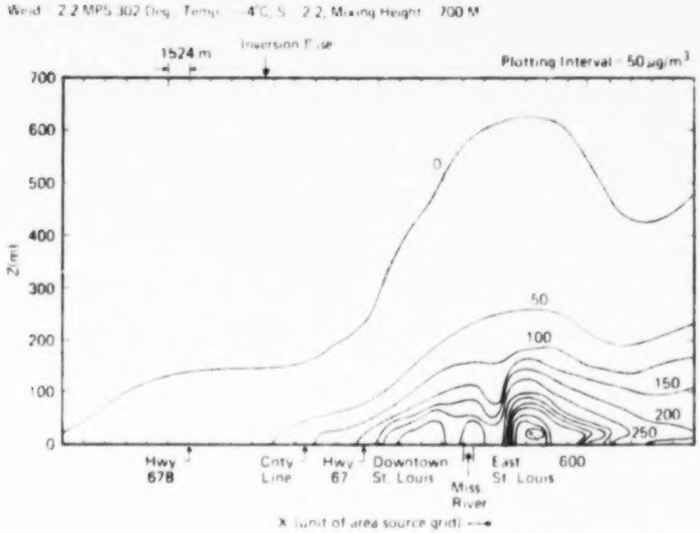

Fig. 11b. Simulation of hourly averaged SO_2 concentration field in the x-z plane.

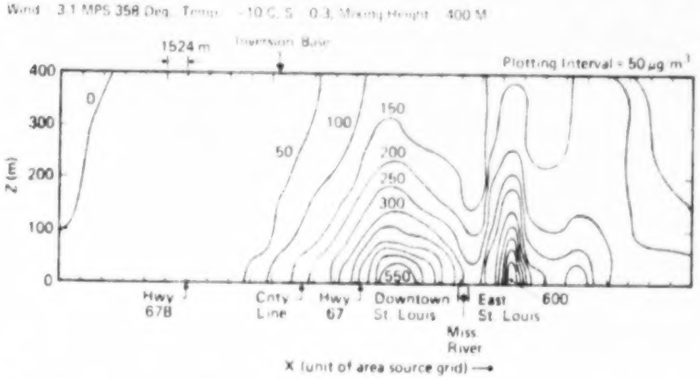

Fig. 11c. Simulation of hourly averaged SO_2 concentration field in the x-z plane.

case due to low mixing under stable conditions. Moreover, the concentration distributions in both cases are not similar, even though they both are for the same wind direction. The local concentration maxima occur on the surface in the former case but not in the latter. The elevated local maximum at East St. Louis in the latter case is due to low mixing in the stable air flow; thus, the plumes from the elevated sources are dispersed slowly. Thus, the vertical concentration distribution along the wind direction is influenced by roughness, stability, and the source position. Fig. 11c shows the crosswind concentration pattern under low north winds and unstable atmospheric conditions. The local concentration maximum was displaced westward due to the different wind direction. The concentrations at downtown St. Louis are largely increased due to the low mixing height and unstable conditions.

From these three figures, it is clear that the vertical concentration distribution of pollutants is neither uniform nor similar in the mixing layer. The hypothesis of constant concentration in the vertical is only achieved (approximately) at a far distance from major source emissions and under unstable atmospheric conditions. The slope of the isopleths on the upwind edge is related to atmospheric stability. Horizontal wind speed has no appreciable effect. Other parameters that might affect this slope are change in surface roughness and spatial distribution of source emission. These figures indicate that the vertical concentration distributions are as irregular as horizontal concentration distributions. Thus, no obvious simplification can be made. Such an attempt requires further investigation.

6. Conclusions and recommendations

The findings of this investigation provide some insight into the relationship between concentrations and sources and their dependence on various parameters. The results also indicate the capabilities and limitations of the modelling approach. The main attractiveness of this model is its rather consistent performance under the various conditions which occurred within the 25-day test period. Consistent performance of the model was especially satisfactory for both strong and light wind conditions. Similar performance was noted for sudden changes of wind directions. This is an improvement over the Gaussian plume model tested for the same time period. In addition, its major advantages are a large flexibility in handling cases with arbitrary distributions of sources with varying emission rates, with spatial and temporal variations of wind (including vertical wind), eddy diffusion coefficients, stability, and mixing height. It also can deal with spatially varying surface roughness and topographical conditions as well as nonlinear chemical reactions. With growing availability of data and the advance in the understanding of urban meteorology, atmospheric turbulence and chemical reactions of pollutants, the full potential of the model will be more appreciated in the near future.

On the other hand, its current disadvantages are those of neglecting microscale variations of pollutants from concentrated sources, and the detailed urban effects upon the pollutant dispersion. The shortcomings of the numerical method are the constraints of the integration time step required by the stability, accuracy criteria, and the inevitable numerical errors. The latter does not appear to be a severe limitation. The newly developed methods (Gazdag, 1972; Orszag, 1971) can provide very accurate numerical results. This method can be applied whenever the accuracy requirement is such that the errors from the current method can no longer be tolerated. More efforts are needed in grid resolution improvement by introducing a subgrid model.

In addition, the effect of the urban area on creating a non-equilibrium atmospheric turbulent structure needs further investigation. This kind of study may give more information on the turbulence diffusion, vertical air motion, and spatial variation of atmospheric stability and mixing height over the urban area. Improvements on the input data are also necessary. The estimated diurnal varying emission rates which are governed by the ambient air temperature seem to be inaccurate during the early periods of unseasonably warm or cold spells. Improvement may be made by considering the effects of the history of the air temperature upon the emission rates. The site of the monitoring station should be selected carefully so that the measurements are free from local influences and therefore provide a better representation of the ambient air quality. The applicability of the bulk Richardson number and the horizontal wind fluctuations to determine the atmospheric stability requires further study. With respect to the procedures for handling the vast amounts of input and output data, some auxiliary programs are needed. Continuous graphic displays of the data and various statistics are very useful in understanding the complex phenomena which result from such an immense amount of data. After all, any attempt at research modeling should first aim toward understanding the overall phenomenon rather than emphasizing the simplicity and convenience of the model.

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6. Finite Difference Scheme for the Horizontal Advection terms of the Concentration Equation.

Finite difference scheme for the horizontal advection terms of the concentration equation.

We shall consider an equation

$$\frac{\partial c}{\partial t} = - \frac{\partial uc}{\partial x} - \frac{\partial vc}{\partial y} \qquad (A\text{-}1)$$

and grids layout as shown in Figure A-1. The notation used in Part I of this report is retained in this section.

We propose that the solution of equation (A-1) is to be approximated by a second order, central finite difference scheme with the application of the flux corrections. A time splitting method* will be employed to compute two terms on the right-hand side of equation (A-1).

Refer to Figure A-1, the rate of change of the mass (concentration value c) at grid point (i,j) is depended on the fluxes cross through the edge surfaces at a, b, c and d. Note that the grid cell represented by the grid point (i,j) has the size of $\frac{1}{2}(\Delta x_i + \Delta x_{i-1})$ and $\frac{1}{2}(\Delta y_j + \Delta y_{j-1})$ in x and y direction respectively. The following discussions apply to non-uniform grid spacings.

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*It is also called "fractional-step method" or "splitting-up method." It is a method to replace a multidimensional problem by a succession of one-dimensional problems. (See Chapters 3 and 4 of "Numerical Methods in Weather Prediction" by G. I. Marchuk, Academic Press, New York, 1974.)

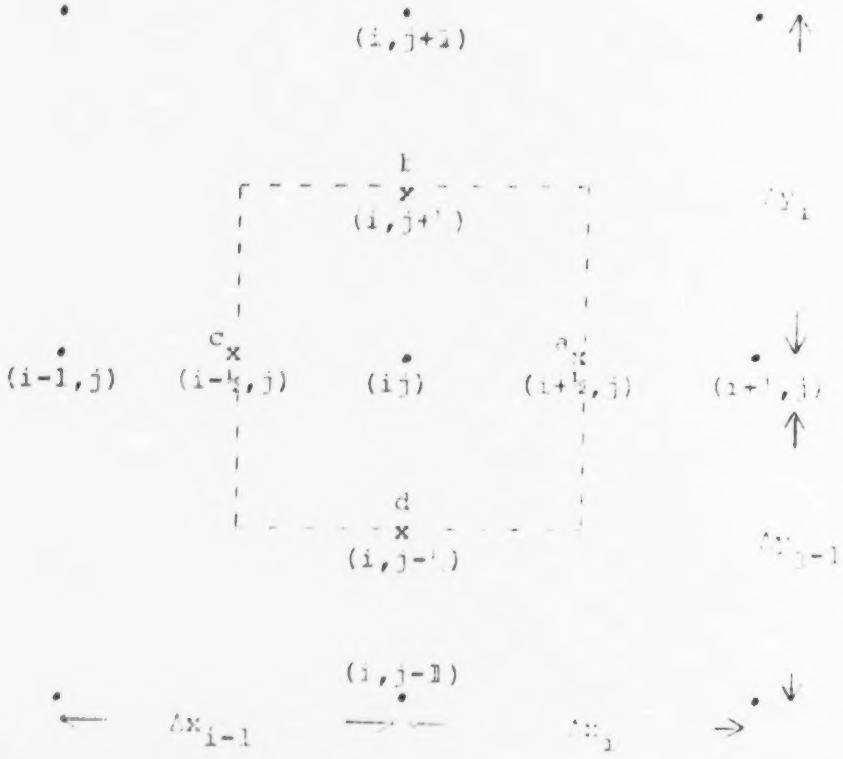
(i,j+1)
b
(i,j+½)
Δy_i
c
(i-1,j)
(i-½,j)
(ij)
a
(i+½,j)
(i+1,j)
d
(i,j-½)
Δy_{j-1}
(i,j-1)
Δx_{i-1}
Δx_i

Figure A-1 Grids layout

Expand C with respect to time at grid points (i,j) in a Taylor's series, we have

$$C_{ij}^{n+1} = C_{ij}^{n} + \left.\frac{\partial c}{\partial t}\right|_{ij} (\delta t) + \left.\frac{\partial^2 c}{\partial t^2}\right|_{ij} \frac{(\delta t)^2}{2} + O\,(\delta t)^3 . \qquad \text{(A-2)}$$

Applying equation (A-1) and assuming u and v do not vary in a time step, (this is relevent to our problem because u and v change every hour) equation (A-2) becomes

$$\begin{aligned} C_{ij}^{n+1} = C_{ij}^{n} &+ \delta t \left(- \frac{\partial uc}{\partial x} - \frac{\partial vc}{\partial y}\right)\Bigg|_{ij}^{n} \\ &+ \frac{(\delta t)^2}{2}\left(\frac{\partial}{\partial x}\, u\frac{\partial uc}{\partial x} + \frac{\partial}{\partial y}\, v\frac{\partial vc}{\partial y}\right)\Bigg|_{ij}^{n} \\ &+ \frac{(\delta t)^2}{2}\left(\frac{\partial}{\partial x}\, u\frac{\partial vc}{\partial y} + \frac{\partial}{\partial y}\, v\frac{\partial vc}{\partial y}\right)\Bigg|_{ij}^{n} , \qquad \text{(A-3)} \end{aligned}$$

or

$$C_{ij}^{n+1} = C_{ij}^{n} + \hat{U}[C_{ij}^{n}] + \hat{V}[C_{ij}^{n}] + \frac{(\delta t)^2}{2}\left(\frac{\partial}{\partial x}\, u\frac{\partial vc}{\partial y} + \frac{\partial}{\partial y}\, v\frac{\partial uc}{\partial x}\right) \qquad \text{(A-4)}$$

----Cross terms----

where

$$\hat{U}[C_{ij}^{n}] = -\,\delta t\, \frac{\partial uc}{\partial x}\Bigg|_{ij}^{n} + \frac{(\delta t)^2}{2}\left(\frac{\partial}{\partial x}\, u\, \frac{\partial uc}{\partial x}\right)\Bigg|_{ij}^{n} ; \qquad \text{(A-5)}$$

$$\hat{V}[C_{ij}^{n}] = -\,\delta t\, \frac{\partial vc}{\partial y}\Bigg|_{ij}^{n} + \frac{(\delta t)^2}{2}\left(\frac{\partial}{\partial y}\, v\, \frac{\partial vc}{\partial y}\right)\Bigg|_{ij}^{n} . \qquad \text{(A-6)}$$

The cross terms in equation (A-4) can be approximated by a time splitting method. If we assume that the computation of the new concentration value at grid point (i,j) is performed as follows:

$$C_{ij}^{*} = C_{ij}^{n} + \hat{U}[C_{ij}^{n}] \quad , \tag{A-7a}$$

and

$$C_{ij}^{n+1} = C_{ij}^{*} + \hat{V}[C_{ij}^{*}] \quad . \tag{A-7b}$$

It can be shown that

$$C_{ij}^{n+1} = C_{ij}^{n} + \hat{U}[C_{ij}^{n}] + \hat{V}[C_{ij}^{n}] + (\delta t)^2 \left(\frac{\partial}{\partial y} v \frac{\partial uc}{\partial x}\right)\Bigg|_{ij}^{n} + O\,[(\delta t)^3] \tag{A-8}$$

By reversing the order of computation of $\hat{U}$, $\hat{V}$ in equation (A-7), we have

$$C_{ij}^{n+1} = C_{ij}^{n} + \hat{U}\,[C_{ij}^{n}] + \hat{V}[C_{ij}^{n}] + (\delta t)^2 \left(\frac{\partial}{\partial x} u \frac{\partial vc}{\partial y}\right)\Bigg|_{ij}^{n} + O\,[(\delta t)^3] \tag{A-9}$$

Equations (A-8) or (A-9) shows that the computational method based on equations (A-7a) and (A-7b) is a good approximation for equation (A-4), if velocity field has a small spatial variation. Thus, equation (A-4) can be represented by

$$C^{n+1}_{ij} = C^n_{ij} + \hat{U}[C^n_{ij}] + \hat{V}[C^*_{ij}] \quad . \qquad \text{(A-10)}$$

The finite difference approximation for equation (A-5) is to evaluate the fluxes across the edge surface at a and c shown in Figure (A-1). Thus,

$$\begin{aligned}\hat{U}[C^n_{ij}] = {} & \Delta t\,[U_c(C^n_{i-1,j} + C^n_{ij})/2 - U_a(C^n_{ij} - C^n_{i+1,j})/2]/\tfrac{1}{2}(\Delta x_i + \Delta x_{i-1}) \\ & - \frac{(\Delta t)^2}{2}\,[U_c^2\,(C^n_{ij} - C^n_{i-1,j})/\Delta x_{i-1} - U_a^2\,(C^n_{i+1,j} - C^n_{ij})/\Delta x_i] \\ & /\tfrac{1}{2}(\Delta x_i + \Delta x_{i-1}) \quad , \qquad \text{(A-11)}\end{aligned}$$

where $U_a = U_{i+\frac{1}{2},j}$ and $U_c = U_{i-\frac{1}{2},j}$. By applying equation (18c) in Section I-2-C-b, equation (A-11) can be rewritten as

$$\hat{U}[C^n_{ij}] = \hat{F}_x[C^n_{ij}] - \hat{F}^*_x[C^n_{ij}] \quad , \qquad \text{(A-12)}$$

where $\hat{F}_x[C^n_{ij}]$ and $\hat{F}^*_x[C^n_{ij}]$ have the same expressions as equations (18a) and (18b) in Section I-2-C-b. Similarly, the finite difference approximation for equation (A-6) is

$$\hat{V}[C^n_{ij}] = \hat{F}_y[C^n_{ij}] - \hat{F}^*_y[C^n_{ij}] \quad . \qquad \text{(A-13)}$$

The flux correction method is applied to compute equations (A-12) and (A-13). For x direction advection, the flux correction method is defined as

$$C_{ij}^{n+1} = C_{ij}^{n} + U[C_{ij}^{n}] \tag{A-14}$$

where

$$U[C_{ij}^{n}] = F_x[C_{ij}^{n}] - F_x'\,[C_{ij}^{n}] \,, \tag{A-15}$$

and

$$\begin{aligned} F_x &= \min\,(C_{i-1,j}\,,\ \hat{F}_x)\,, \quad \text{if } \alpha_{xi} > 0 \;; \\ &= \min\,(C_{ij}\,,\ \hat{F}_x)\,, \quad \text{if } \alpha_{xi} < 0 \,, \end{aligned} \tag{A-16a}$$

$$\begin{aligned} F_x' &= \min\,(C_{ij}\,,\ \hat{F}_x')\,, \quad \text{if } \alpha_{x\,i}^{*} > 0 \;; \\ &= \min\,(C_{i+1,j}\,,\ \hat{F}_x')\,, \quad \text{if } \alpha_{x\,i}^{*} < 0 \,. \end{aligned} \tag{A-16b}$$

Similar treatment is applied to y direction advection. Thus the finite difference formula for equation (A-1) is

$$C_{ij}^{n+1} = C_{ij}^{n} + U[C_{ij}^{n}] + V[C_{ij}^{*}] \tag{A-17}$$